222-WP-003-001

ECS Evaluation Packages Strategic Plan - EP6 Version

White Paper

White Paper—Not intended for formal review or Government approval.

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RESPONSIBLE ENGINEER

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Abstract

Evaluation Packages are an early delivery mechanism that allow portions of ECS functionality to be placed into the hands of selected users for evaluation and design iteration in advance of formal system releases. As such, they help avoid late discovery that what has been produced is not that which is desired.

This white paper describes the plan and process for the delivery and evaluation of the ECS Evaluation Packages (EP). The objectives of this document are to 1) provide an overview of the EP process to set the context for planning, 2) define a projected plan for the content of each evaluation package delivery, and then 3) define the detailed process structure for development, test, installation, evaluation, and maintenance of those deliveries. This document is intended to evolve, reflecting the continuously improving EP process, based on lessons learned during the incremental development, prototyping, studies and evaluation process.

This version of the white paper was prepared during the development of EP6.

For a rapid overview of the EP plan see the following items :

- EP Schedule (Figure 2-2)
- EP Lifecycle (Figure 2-6)
- Development Methodology by Subsystem (Table 3-2)
- Summary of Content by EP (Table 3-3)
- SDPS Content (Figure 4-1)
- CSMS Content (Figure 5-3)
- EP Evaluations: Methods and User Groups (Table 10-1)

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4. SDPS Deliveries by EP

5. CSMS Deliveries by EP

* At the time of this writing, PW3, EP7, EP8 are not officially funded. The information given here reflects future anticipated EP plans.

6. Science Datasets and Science Support Scenarios

7. Intersegment EP Interfaces

8. EP Integration and Test

9. EP Resources

10. Evaluation Process

11. EP Maintenance and Operation

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Abbreviations and Acronyms

1. Introduction

1.1 Purpose

This white paper describes the plan and process for the delivery and evaluation of the ECS Evaluation Packages (EP). The objectives of this document are to 1) provide an overview of the EP process to set the context of planning, 2) define a projected plan for the content of each evaluation package delivery, and then 3) define the detailed process structure for development, test, installation, evaluation, and maintenance of those deliveries.

1.2 Related Documents

This document was developed using the concepts and processes described in several ECS White Papers, ECS CDRLs and EOSDIS Planning Documents. The documents that are most closely related to this EP Strategic Plan are:

107/MG1	Level 1 Master Schedule, Current Issue
108/MG2	Intermediate Logic Network Diagrams, Current Issue
201/SE1	ECS System Engineering Plan, Current Issue
222-TP-003-006	ECS Release Plan Content Description, May 1995

Note: This is only a subset of the full set of applicable documents.

1.3 Organization

Summary descriptions for each section of this white paper are provided in Table 1-1.

1.4 Review and Approval

This White Paper is an informal document approved at the ECS Office Manager level. It does not require formal Government review or approval; however, it is submitted with the intent that review and comments will be forthcoming.

This draft version of this white paper is being circulated for EP6. Comments on this paper should be directed to Naveen Hota via the contacts listed below.

The plans and objectives expressed in this White Paper remain valid until superseded by the next release. The concepts presented here are expected to be consistent with the ECS System Engineering Plan, CDRL 201.

Table 1-1. Section Descriptions

	Section	Description
1.	Introduction	Purpose and Organization of this White Paper, Related Documents, and Contacts for further information
2.	EP Process	Description of EP Process including EP Master Schedule, relationship with incremental development and prototypes, detailed description of an EP Life Cycle, and EP evaluators.
3.	EP Strategy Development	Development of EP strategy based upon capabilities required for Release A of ECS. Guidelines for determining content for incremental development are provided.
4.	SDPS Deliveries by EP	An overview of the SDPS development is followed by the SDPS EP strategy and summary descriptions of the content of each EP and Prototype Workshop.
5.	CSMS Deliveries by EP	An overview of the CSMS development is followed by the CSMS EP strategy and summary descriptions of the content of each EP.
6.	Science Datasets and Science Support Scenarios	Description science scenarios to be used for the EP evaluations along with the datasets to be used
7.	Segment EP Interfaces	Timeline for the development of segment-to-segment interfaces required for EPs.
8.	EP Integration and Test	Process and organization for conduction the Integration and Test of EPs.
9.	EP Resources	Description of the present workstations and networks available for EPs
10.	Evaluation Process	Description of the process to be used for eliciting comments on the EPs
11.	EP Maintenance and Operation	Describes the M&O tasks of EPs and the responsible organizations.
	Acronym List	

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2. EP Process

2.1 Evaluation Packages Overview

The ECS Team has defined a multi-track development approach that includes an incremental development track that will build the full functionality of portions of the ECS in parallel with formal-track development of other portions of ECS. Evaluation Packages are the early delivery mechanism that allows portions of ECS functionality (incremental and prototype) to be placed in the hands of selected users for evaluation and design iteration in advance of formal system releases. Evaluation Packages bring together increments and prototypes for deployment and evaluation (Figure 2-1)

Evaluation Packages (EPs) provide predefined dates for delivery of individual increments and selected prototypes (Figure 2-2). The planned content of each EP delivery is documented in this white paper. The feedback from one EP influences the objectives and design for the next. Each EP builds upon and expands the capabilities of previous EPs, until the last EP in the series supporting a formal release, when the software is migrated to the formal track for integration, acceptance testing, and formal delivery.

Each EP may incorporate selected prototyping efforts from the ECS segments. Prototypes are selected for inclusion in an EP primarily based upon their function and content and their relation to the goals of the EP, and on their need for evaluation by multiple users in the community.

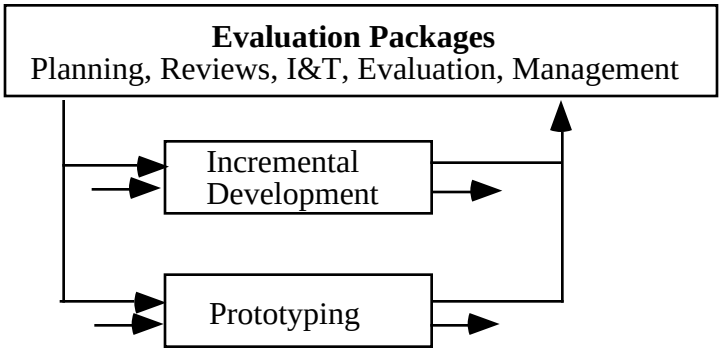

Figure 2-1. Evaluation Packages Delivery Mechanism of Increments and Prototypes

Section 2.1 provides the summary EP Schedule and Milestones. The EP Process (Section 2.2) describes the process by which increments and prototypes are brought together to form EPs.

2.1.1 EP Schedule

Key activities and milestones associated with the overall Evaluation Package process leading to Release A & B are shown in Figure 2-2 and Table 2-1. The EP Schedule reflects a maturing of the EP process requiring more complexity to meet the various needs which EPs satisfy. In particular, are two items: 1) Delivery of CSMS functionality and 2) the addition of SPDS Prototype Workshops. CSMS will be delivering infrastructure to support SDPS EP6 development along with CSMS specific items. The SDPS Prototype Workshops are the result of the desire to feed comments on an EP directly into the next EP. In order to get the direct feedback and to provide the user evaluation needed for the incremental development, SDPS Prototype workshops have been added. These workshops will allow collection of user evaluation with direct developer assistance, thereby avoiding the more rigorous I&T required for EP deployment and independent evaluation.

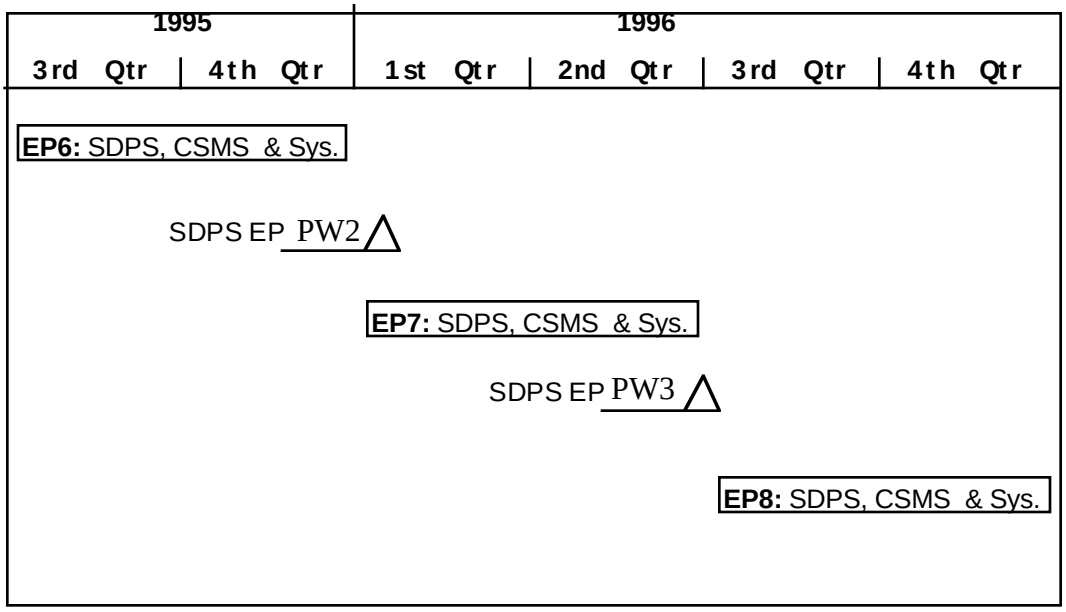

Figure 2-2. EP Schedule Leading to Release A & B

Table 2-1. Key EP Events Leading to Release A & B

Event	Date
EP6 Development (CSMS, SDPS & System)	
- EP6 Objectives Review	06/20/95
- EP6 Design Review	08/04/95
- EP6 Test Readiness Review (TRR)	10/09/95
- EP6 Consent to Ship Review (CSR)	10/31/95
- EP6 Evaluation Readiness	11/16/95
EP Prototype Workshop 2 (SDPS)	01/96
*EP7 Development (CSMS, SDPS,& System)	
- EP7 Evaluation Readiness	6/96
*EP Prototype Workshop 3 (SDPS)	7/96
*EP8 Development (CSMS, SDPS & System)	
- EP8 Evaluation Readiness	11/96
Release A TRR	04/96
Release B TRR	12/96

*At the time of this writing, PW3, EP7, EP8 are not officially funded. The information given here reflects future anticipated EP plans.

2.1.2 Incremental Development Overview

Incremental development is described in detail in Section 8 of the ECS Systems Engineering Plan (ECS Document 194-201-SE1-001, June 1994). A summary is provided here to aid the understanding of the EP Process in Section 2.2.

Instead of a single waterfall of sub-phases, the incremental process uses multiple incremental development cycles, including user evaluation, prior to integration with formally developed software. Figure 2-3 illustrates how multiple incremental development cycles support a release. The number of increments shown in Figure 2-3 is illustrative with the specific number of increments for a release based on specific release plans.

The incremental development approach involves a customer selected segment of the user community in the process of prototype product evaluation. Capabilities are demonstrated frequently in a "build and test a little, evaluate a little" development progression. Software built in one increment supersedes and provides more capabilities than the software in the previous increment. The incremental development process leads up to the integration of incrementally developed components into a formal release via conformance to design standards and the migration of documentation into the formal process.

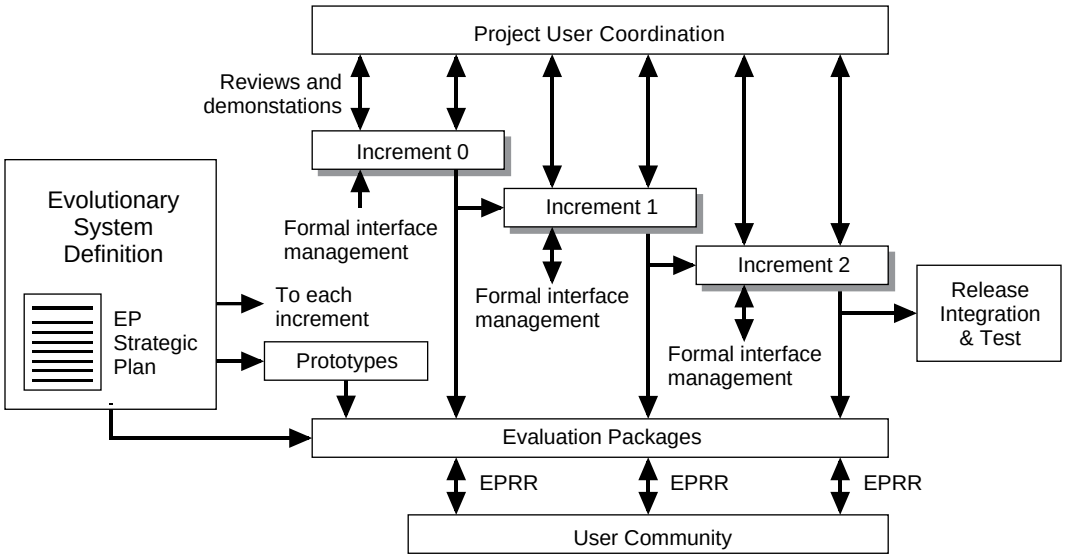

Figure 2-3. Incremental Developments for a Release

A single incremental development cycle has stages similar to those found in formal development (see Figure 2-4). An incremental development cycle is composed of the following stages: 1) Objectives Definition, 2) Design, 3) Implementation, 4) Integration and Test, 5) Maintenance and Operations, and 6) Migration. Incremental development starts with objective definition and Level 3 requirements trace, generally corresponding to requirements development in the preliminary design stage of formal development.

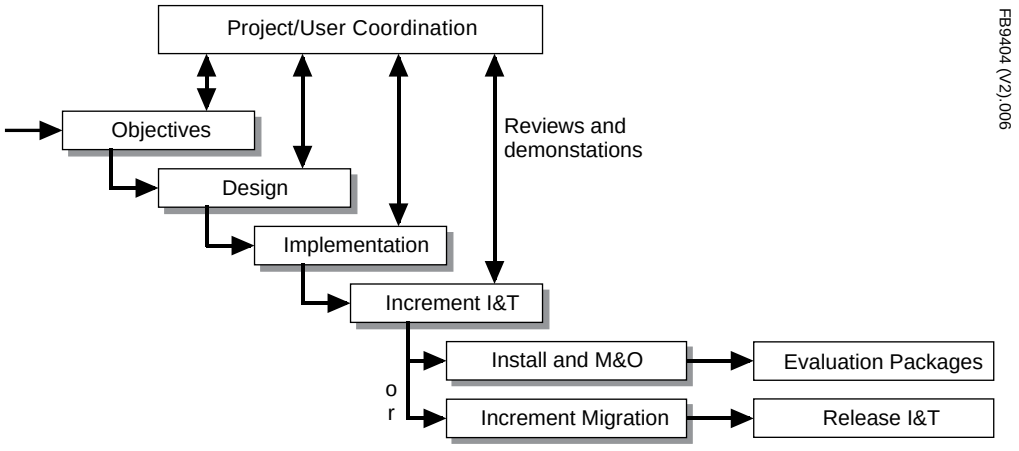

Figure 2-4. Incremental Development Stages

Both incremental development and formal development have design, implementation, integration and test, and maintenance and operations stages. However, the contents of each of the above cycles differs between formal and incremental development due to the iterative nature of the incremental track. In particular, documentation generated during incremental development is initially produced in a more streamlined fashion, e.g., in development "notebooks" maintained by developers, in white papers, in briefing charts, and in system demonstrations. Also, reviews are accomplished as a part of regularly scheduled coordination meetings.

The Objectives Notebook developed during Objectives stage is developed in accordance with the ECS Project Instruction for Incremental Track Objectives Folder (Draft PI, Number to be assigned).

Other folders developed on the incremental track may include white papers, briefing charts, or annotated charts, available electronically or hard copy, as appropriate to convey the information. To allow for ease of generation of formal documentation, priority is given to using a template during the increment that is in the formal documentation format

Peer Reviews conducted during the Design stage are conducted in accordance with the ECS Project Instruction for Inspections and Reviews (PI Number SD-1-004).

2.1.3 Engineering and EP Prototypes

Prototypes which are utilized for EP purposes may be of two types: 1) Engineering Prototypes and 2) Development Prototypes. Engineering Prototypes are developed in accordance the ECS Prototyping and Studies Plan (ECS Document 194-317-DV1-001, May 1994). Development Prototypes for EPs follow a similar process with one major exception: this EP Strategic Plan White Paper is used as the planning record instead of the Prototype Database defined for Engineering Prototypes. A summary of the prototyping process is provided here to aid the understanding of the EP Process defined in Section 2-2 (see ECS Prototyping and Studies Plan for a complete description).

Figure 2-5 shows the identification, selection, execution/ evaluation and incorporation steps of the prototypes and studies for Engineering Prototypes on the ECS project. Table 2-2 provides a summary description of each step.

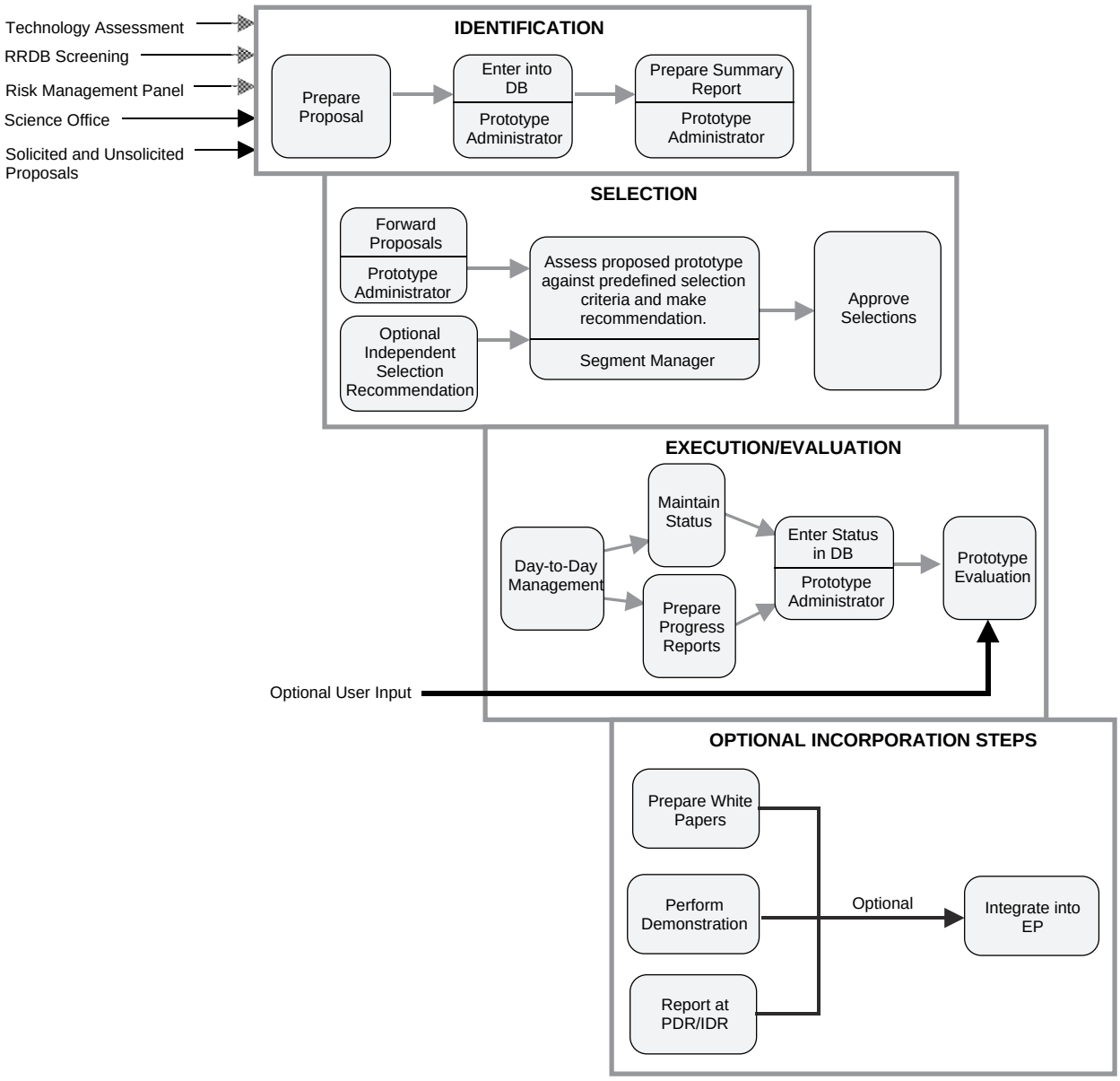

Figure 2-5. Prototypes & Studies Process

Table 2-2. Prototype Process

Step	Description for Engineering Prototype	Description for Development Prototype
Identification	• Short proposal (one to two pages) prepared by organization proposing the prototype • Prepared in accordance with Prototype and Studies Plan (317/DV1) • Submitted to Prototype Administrator for entry into prototype database	• Modified version of the Objectives Folder which documents areas of uncertainty in the design of the component
Selection	• Prototype Administrator forwards proposal and funding source to selection review personnel • Approval authority determined by funding source • participants to implement and evaluate the prototypes are listed	• Proposal reviewed at EP Objectives Review • Participants and implementers determined by EP process
Execution/ Evaluation	• Prototype Lead responsible for managing day-to-day tasks • Quarterly Prototype Status Reports in conformance of DID 318/DV3 • Status prototype maintained by Prototype Lead and forwarded to the DTR and Prototype Administrator • User involvement through demonstrations and inclusion into EPs where appropriate	• Segment EP managers responsible for managing day-to-day tasks • Status part of EP Life Cycle Reviews (see section 2.3) • User involvement through EP process
Incorporation	• Determined by Development Team Representative and Evaluation Team Leader • If prototype results are to be used in ECS implementation, a complete set of required documentation and testing must be accomplished to support the requirements of the incremental or formal development track.	• Determined by Development Team Representative and Evaluation Team Leader • Documentation for incremental development developed as part of EP cycle in which the prototype becomes an increment

2.2 EP Process

EPs are a delivery and evaluation mechanism for incremental and prototype developments. The discussions which follow speak of the “EP process” for uniformity in this paper, but it must be remembered that the incremental prototype products are the items of development. The EP process provides an integrating and complete life cycle structure for the prototypes and increments.

The challenge for EP life cycle design is to provide just the necessary amount of structure without creating an administration overload that totally removes the freedom to react to objectives and design changes dictated by evolving circumstances. That challenge has been

accomplished with the design of an EP life cycle that adopts selected practices from more traditional engineering methods, and applies them to the rapid prototyping form originally intended. These include the following features:

- Objectives setting and review.
- Design coordination and review.
- Documentation in Program Development Folders.
- In-process demonstrations and peer reviews with feedback to adjust implementations.
- Frequent EP team status assessments and planning adjustments.
- Early participation of test personnel in product testing.
- Progressive, semi-formal, integration and test.
- EP Consent to Ship Reviews.
- EP Evaluation Readiness Reviews.

Experience to date indicates that the minimum time to produce meaningful content in an EP is about six months, and that evaluation of the EP will require an additional two months including time for data analysis and results sharing. The actual time for a given EP will depend upon the defined content of that EP.

The structure of each EP life cycle is shown in Figure 2-6. A time scale in weeks and months from start date provides a relative time reference to events. The duration of the cycle for each EP is minimized by parallel design prototyping with more formal design work, and by overlapping the evaluation period of the first EP (EPn) with the start up of the next (EPn+1). Extra discipline must be applied in the latter instance to assure that the evaluation results from EPn actually do make maximum contribution to the evolution into EPn+1.

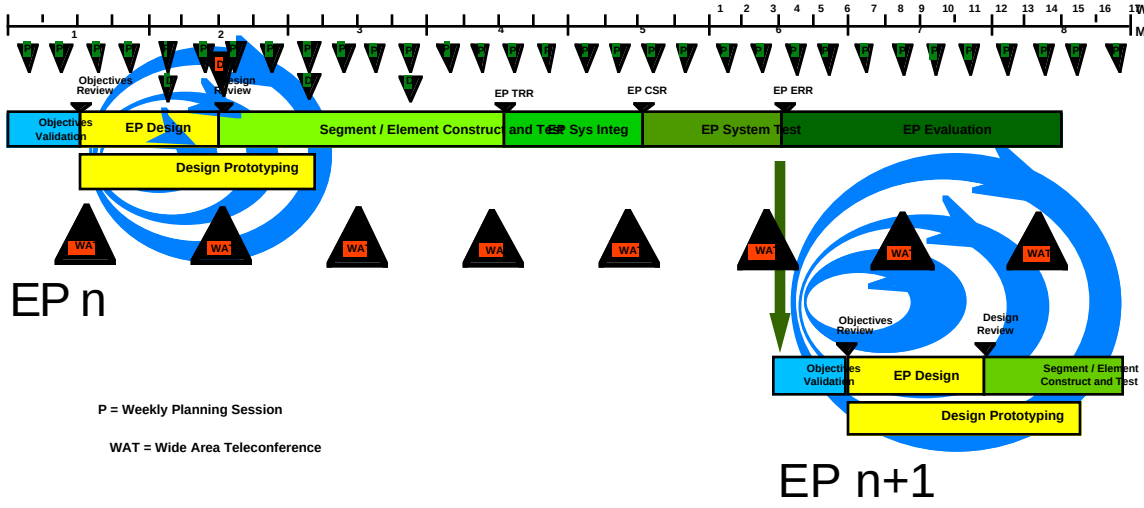

Figure 2-6. EP Life Cycles

Maximum visibility into the EP process for all interested parties is our goal, and participation by ESDIS, DAAC, and user personnel is encouraged. The following activities are included in the EP Life Cycle design to afford the visibility desired.

- EP Planning and Coordination Sessions - Weekly discussion of status against plans, accomplishments, problems encountered, and near-term activities.
- Wide-Area Telecons - Teleconferences, including interested personnel, cover monthly reviews of status against plans, accomplishments, problems encountered, and mid-term activities for each EP participant. Emphasis is placed on larger issues of interest to the broader scope of participation.
- Demonstrations - Informal, as well as more structured, demonstrations of accomplishments to date are included in the EP process to afford every opportunity for customer and user input to the evolving design implementations. Informal demos can take place whenever a significant new level of changes has been implemented and can occur whenever personnel are available to conduct and view the demos. More structured demos are planned at key points in the life cycle where they make sense for the items being developed. As a minimum, structured demos will be included in the Semi-Formal Reviews conducted in the later stages of I&T.
- Semi-Formal Reviews - The EP life Cycle includes sufficient management control to assure that EP developments follow agreed to methodology and standards, make acceptable progress toward agreed to functionality and schedules, and that the products deployed include the quality required in ECS products. This control is offered through semi-formal reviews. They are “semi-formal” in that they entail no advance hardcopy, use relaxed-format presentation materials, have no RID process, and no compulsory attendance list (except for developers). These reviews include an informal Objectives Review, Design Review, Consent to Ship Review, and an EP Evaluation Readiness Review. Each is described in purpose and content below.
- Peer Reviews - EP developments are performed in a small-team work group environment with daily interaction and informal coordination of designs, implementation requirements, and accomplishments Ad Hoc technical interchange discussions are a normal part of this process and assist the coordination process. More structured peer review and coordination sessions are called by EP management whenever issues are uncovered by this process or in the weekly planning and coordination sessions.
- Segment ETM Status Meetings/demos - Each segment has its customer counterpart and established review meetings. EP accomplishments are routinely reported and demonstrated in these forums with pointed focus on the special concerns of each segment.

Each of the phases of the EP life cycle, shown in Figure 2-6, is described in more detail below.

2.2.1 Objectives Validation

The development cycle of each EP begins with a review of the previously defined goals and objectives for the EP (as documented in the current version of this paper). Goals and objectives are updated with lessons learned from recent EP development and test activities, and with results coming from the evaluation of previous EPs. The main items to be revalidated include:

EP Objectives - The purposes to be achieved by deploying the services at this time, as contained in the EP Strategic Plan.

Incremental Questions and Metrics - Detailing of EP Objectives as contained in the Incremental Objectives Folder.

Process Objectives - The development management and administrative process objectives that are to be explored in the EP.

Process Capabilities - The detailed process procedures to be implemented to achieve the process objectives.

EPn COTS Requirements - Definition of the COTS hardware or software required to implement the EP, assurance of its availability, or initiation of its procurement.

2.2.2 Objectives Review

A semi-formal review involving ESDIS, ECS Science Advisors, DAAC representatives, all developers, test and integration, and support functions. Proposed goals and objectives for the current and projected EPs are presented, discussed, and agreed upon. Agreements are documented following this review and published in an update to this paper.

2.2.3 Design

Design Process - Decomposition of functions into units of architecture (functions - threads - builds - modules/objects, etc. as appropriate), and identification and definition of interfaces therein.

Design Prototyping - coding of elements of functionality for early experimentation with implementations.

Design Documentation - Development Folders

- Interface Control Documents

- COTS Requirements Table (specs)

2.2.4 Design Review

The EP Design Review is a semi-formal review involving ESDIS, ECS Science Advisors, DAAC representatives, all developers, test and integration, and support functions. Proposed designs for the items included in the EP are presented in vugraph form, discussed, and agreed upon. Agreements are documented in updates to the presentation vugraphs and included in the development folders following this review. A collected set of updated and commented

presentation materials is published for all participants and becomes the design baseline for the EP.

2.2.5 Construct and Unit Test

Construction of software begins with approval of designs and interface definitions. Software is written to ECS software standards to assure reusability with little rework. All modules are created, updated and maintained under the ECS software configuration management system. The build/thread methodology is followed to create and integrate modules in meaningful sequences building toward the design functionality intended. At the point where predefined threads have been successfully tested to allow the integration of those threads into a Build, an informal TRR is held to transition software ownership from developer control to EP Integration and Test Organization control. This is accomplished by "promoting" the modules in the CM library. Design changes, which were encouraged for evolution until this point, are ended at TRR.

2.2.6 Design Freeze

Design changes must be suspended in even the most free development environment at some point in time to establish a stable baseline for test and integration of multiple system components. The design freeze for EP software occurs at the TRR associated with transfer of CM control from development to EP Test. Subsequently, the only software changes allowed are to fix recorded discrepancies.

2.2.7 EP Integration and System Test

EP integration and system test are performed in two phases divided by a Consent to Ship Review. Activities in these phases are performed by the EP I&T group made up of personnel from the I&T organizations of the segments and the SI&P Office. Leadership of the group rotates with each EP. Configuration management responsibility for this phase belongs to the test group, and a formal Discrepancy Reporting (DR) tool is used to prioritize and track problems discovered. Daily activity review and planning sessions, overseen by EP management, and attended by test, and development people, are held during this phase.

EP Integration - Integration is performed at the EDF, bringing together the software builds from the elements and segments, in the specified computing and communications environment, into a functional whole.

Consent to Ship Review - This review is held when the integration testing indicates that the EP is functioning well and all DRs which might compromise its operation have been resolved. The purpose of the CSR is to demo the system to ECS, ESDIS and DAAC representatives, to review the test status with them, and to obtain approval to move the EP to broader visibility by installing it at the DAACs for system-wide testing.

System Test - The system test period includes EP installation and check out by the test group, training and familiarization of the DAAC liaisons and staffs, and a system-wide exercise of the EP with all participating DAACs. The purpose of the system exercise is to assure the soundness of the EP under multi-user loads and to demonstrate readiness to support the EP evaluation phase.

2.2.8 EP Readiness Review

The EPRR is conducted at the end of the system-wide exercise to review occurrences in the exercise. If it was successfully concluded (no unexplained, or priority 1, (show-stopper) problems), the EP is declared ready for use in the evaluation environment by its intended evaluators.

2.2.9 Evaluation

EPs are evaluated by three user groups with data collected via three evaluation methods. The three user groups are science users, operations and users services, and ECS developers. The three evaluation methods are Usability Testing (UT), and Evaluator Preference Survey (EPS) and API evaluation. Each of the user groups and the evaluation methods are described in Section 10.

The life cycle for an EP is completed as its evaluation is finished and the results from that evaluation feed into the beginning phase -- Objectives Validation -- of the next EP. The first EP remains installed at the DAACs during the Development and Test phases of the next EP to continue evaluative use in that user environment. Feedback continues to influence the development of the next, and later generation, EPs.

3. EP Strategy

EP Strategy was developed using a subset of the content required for Release A and B and by the needs of the incrementally development items for user evaluation. This section provides the link to the ECS Release Plan with respect to the content suited to EP evaluation and incremental development (Section 3.1). Additional considerations for EP content are based on incremental development by segments (Section 3.2). An overall summary of the EP strategy includes the content provided by each segment, associated data and evaluation (Section 3.3).

3.1 EP Strategy Development

3.1.1 Formal Releases Drive EP Planning

EP Strategy Formulation described in this section is based on the a subset of the functionality defined for Release A and Release B in the ECS Release Plan (Figure 3-1). This section explains how specific driving requirements for ECS development relate to the EP strategy.

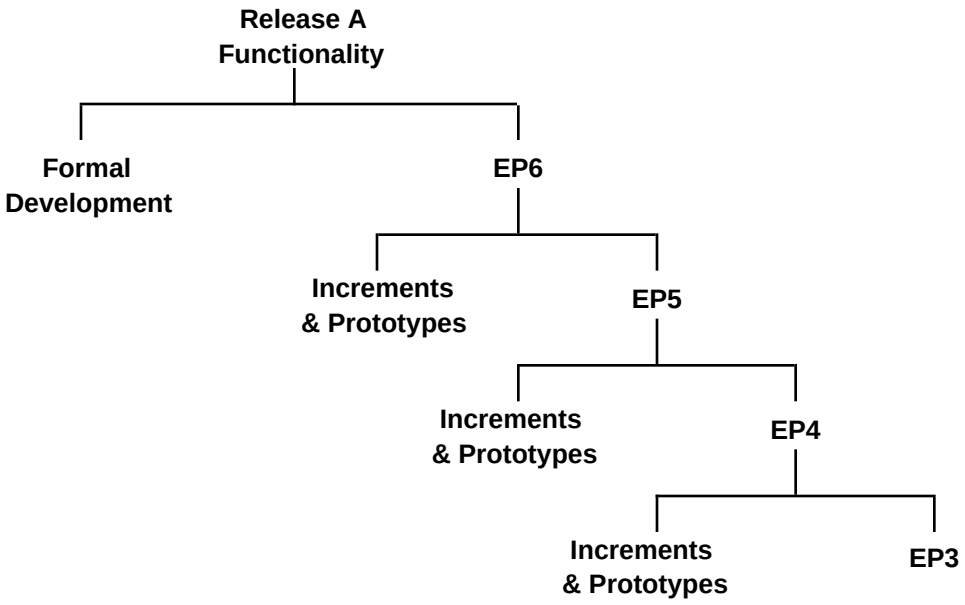

Figure 3-1. EP Strategy Formulation

3.1.2 Guidelines: Formal vs. Incremental Development

Purposes of the formal and incremental development tracks are stated in the ECS SOW as follows:

> "Incremental Development may be used for those areas of the system where requirements are less well understood and iteration of requirements and design is anticipated with user evaluation. Formal Development shall be used where requirements are more mature and stable or mission critical. Incremental development may also be used in COTS intensive parts of the system and to develop system infrastructure in support of other incremental developments."

Also from the ECS SOW is the purpose of the Evaluation Packages:

> "Evaluation Packages are a delivery mechanism for early deployment of Incremental Developments and selected Prototypes. The purpose of the Evaluation Packages is to solicit user evaluation early in the development cycle."

It is with these guidelines in mind the that the strategy for EP is formulated in the next sections.

3.1.3 Release Plan as Basis for EP Strategic Planning

The ECS Release Plan has the following structure and logic:

- Identification of External Driving Requirements (Section 5)
- Assignment of the Driving Requirements to Releases (Table 7-2)
- Identification of the Segment Functions needed to satisfy the Driving Requirements (Section 6 Tables)
- Detailed Identification (Service Class level) of Segment Services by Release (Section 10)

The structure and content of the release plan is used to determine driving requirements for the EPs in the following steps:

- Based on Section 5 of the Release Plan and the guidelines listed in the previous section of this white paper, Identify the External Driving Requirements which have "Uncertainties"
- Based on the previous step and the allocation of driving requirements to release (Table 7-2 in the Release Plan), Identify Release A, "Uncertain" Driving Requirements. (The results of this step are listed in the next section of this white paper.
- The Release A, "Uncertain" Driving Requirements are then an input to the segment planning for incremental and prototype developments which along with development considerations were used to develop Tables 5-1 and 6-3.

3.1.4 "Uncertain" Driving Requirements in Release A and B

The items listed in Table 3-1 are the result of the EP Strategic Planning process described in the previous section. These are a subset of the overall ECS External Driving Requirements for Release A. The complete list is in the ECS Release Plan.

The items in Table 3-1 can be found in the SDPS Strategy, Table 4-1, with the exception of V0 Data Migration. V0 Data Migration is a separate task being conducted by the ECS contractor. EPs are dependent upon V0 Data Migration as described in Section 6.

Table 3-1. "Uncertain" Driving Requirements in Release A and B

V0 Interoperability
User Services - Search Using Combinations of Logical Operators - Display of Data Timeline (metadata visualization) - API for Update, Query and DBA Utilities (inventory, guide directory) - Data Visualization Capabilities - On-line User Survey at all Sites
V0 Data Migration

3.2 Incremental Development

Although determination of which elements of ECS are best suited for incremental development is based on requirements volatility, it is subsystems which are developed incrementally not requirements. The state of the requirements and the anticipated interaction with users with respect to the requirements provides indications to which portions of the system are best suited to incremental development. The choice of what is developed incrementally is done on a system partitioning basis, e.g. subsystem by subsystem basis. With respect to EP strategy, selecting subsystems to be developed incrementally means that there is additional EP content beyond the content based solely on requirements uncertainty (see Section 3.1). Additional issues concerning development, e.g. timing of critical prototypes and COTS selection, are discussed in Section 4.1 for SDPS and 5.1 for CSMS.

A summary of the development approach and support of EPs by ECS subsystem is shown in Table 3-2. The main area of incremental development and associated EP evaluation are those areas in most direct contact with the science users, e.g. SDPS client, Interoperability, Data Management. Although the CSMS subsystems Internetworking Subsystem (ISS), Systems Management Subsystem (MSS) and the SDPS Data Server Subsystem are developed formally, the EPs rely on support from these subsystems.

3.3 Summary of EPs

This section provides an overview of the content of the EPs and EP Prototype Workshops. Table 3-3 summarizes the content for each segment, the associated data and evaluation methods. Details on SDPS content can be found in Section 4. Details on CSMS content can be found in Section 5. Details on data sets for EPs can be found in Section 6. Details on evaluation methods and evaluators content can be found in Section 10

Table 3-2. Development Methodology by Subsystem

Segment	Subsystem	Development Methodology	EP Support (If not incremental)
SDPS	Client	**Incremental**	
SDPS	Interoperability	**Incremental**	
SDPS	Data Management	**Incremental**	
SDPS	Data Server	Formal	**yes**
SDPS	Ingest	Formal	
SDPS	Planning	Formal	
SDPS	Data Processing	Formal	
CSMS	CSS	**Incremental**	
CSMS	ISS	Formal	**Yes**
CSMS	MSS	Formal	**Yes**
FOS	User Interface	Formal	
FOS	Planning & Scheduling	Formal	
FOS	Data Management	Formal	
FOS	Command Management	Formal	
FOS	Command	Formal	
FOS	Resource Management	Formal	
FOS	Telemetry	Formal	
FOS	Analysis	Formal	

Table 3-3. Summary of Content by EP

	SDPS Content	CSMS Content	Data	Evaluations
EP6	- Data Type Service - Metadata Search Acquire - Advertisement Creation - User Registration - Integration of Tools	- Event Services - Management Services - ECS to V0 Interoperability	- GCMD in advertising + appropriate directories in Data Server (ERBE, ISCCP) - EDC Inventory - Subset of ERBE, ISCCP	- Usability Test and Survey of Science Users - Usability Test of Operations Users
PW2	- Product Access - Processing Request - Request/ Results status - ASTER Acquisition Request Prototype - Multi Data Server Searches (LIM)	(none)	(same as EP6)	- Usability Test of Science Users
***EP7**	- Coincident Searching - Subscriptions - Hypertext Authoring - Guide search ECS to V0 Interoperability DCE Multi-Cell Deployment Remote File Access (DFS) Transaction Processing Network Management Data Collection Fault Management	- Asynchronous Message Passing - DCE Multicell deployment - DCE DFS - Transaction Processing - Network Management - Management Services - ORB prototype - Mode Management	- EP6 data - TBD	- Usability Test and Survey of Science Users - Usability Test of Operations Users
***PW3**	Remaining functionality for V1 Client Final versions of all the tools in PW2 Remaining functionality for Data Management from PW2 Data Dictionary, LIM, Gateway, DIM	None	- TBD	- Usability Test and Survey of Science Users

* At the time of this writing, PW3, EP7, EP8 are not officially funded. The information given here reflects future anticipated EP plans.

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4. SDPS Deliveries by EP

4.1 SDPS Development Plan Overview

The purpose of this section is to provide an overview of the SDPS plan for the incrementally developed components that will be released via an Evaluation Package (EP), as well as a plan for the prototyping components that will be released via an EP. The planned development process is more specifically defined in the following documents : the Software Development Plan for the ECS Project, the System Engineering Plan, and the Incremental Development Plans. This section will focus on the components destined for EP incorporation, rationale for development track allocation, and schedule and dependencies considerations.

4.1.1 SDPS Subsystems

The SDPS functions have been grouped into subsystems, which provide a method for a logical structure of the system design. Each subsystem is comprised of collections of related functions, which are in turn are organized into SDPS services. Each type of SDPS service consists of a set of software design objects. The ECS System Design Specification Section 4 details each SDPS Subsystem. An overview of SDPS Subsystems/components that will be developed incrementally or prototyped for EP incorporation, and a brief description of each subsystem follows (see the System Design Specification (ECS Document 194-207-SE1-001) for more detail):

- **Client Subsystem**

  This subsystem provides the science user interface to the SDPS. It consists of a Scientist Workbench and a Desktop Component. The Scientist Workbench contains various tools, and the Desktop provides convenient methods for organizing the user interface objects, and setting interface preferences. User interfaces for operators are developed by the subsystem for which the interface applies. These are not developed as the client subsystem although they may be accessible from the desktop.

- **Interoperability Subsystem**

  SDPS is architected as a collection of distributed applications. The applications use the functions of the CSMS Communications Subsystem and Internetworking Subsystem to cooperate with each other. The Advertising Service is the SDPS component of the Interoperability Subsystem that allows users to access DAAC-unique or non ECS services.

- **Data Management Subsystem**

  This subsystem provides the functions which are needed to locate, find and access earth science and related data in the ECS databases and in data systems with which ECS interoperates. This subsystem includes distributed search and retrieval functions called the Distributed Information Management (DIM) functions, components which act as each site's gateway into its earth science databases called the Local Information

Management (LIM) functions, and a Data Dictionary (DD) function which users can access to obtain explanation of available data and the attributes of the data.

- **Data Server Subsystem**

  This subsystem provides the physical storage access and management functions for the ECS earth science data repositories. It can be accessed directly by other subsystems, or by the Data Management subsystem for distributed searching. The Data Server Service and Data Type Service are now part of formal track development not incremental track. Where identified, the DSS will support EP6 with prototype deliverables.

4.1.2 Development Track Allocation

The SDPS subsystems/components that are allocated to the Incremental Development track are those where requirements are less well understood and iteration of requirements and design is anticipated, and those subsystems/subsystem components which will use COTS extensively. The Client Subsystem requires both DAAC and Science community iterative interaction to understand requirements and is expected to be COTS intensive. The Data Management Subsystem is expected to also require iteration of requirements and design. The Advertising Service of the Interoperability Subsystem will require DAAC/Science community iterative interaction. The Data Server Subsystem is needed in order to provide functionality to the Client, Data Management, and Advertising components. The Data Server subsystem will provide prototype functions to support the other SDPS services.

4.1.3 Release Planning and Dependencies Considerations

The components/objects that should/could be developed incrementally based on the Release Plan are: non-mission critical components, user interface framework components, and distributed search components. In addition, consideration must be given to reducing risks via constructive interaction with scientists and DAAC's (prototyping workshops), and reducing risks of immaturity of object models and user models via iterative implementation, which allows the developer to rework non-mature components before TRR. Taking advantage of the latest vendor products/class libraries is also another consideration when developing incrementally.

4.1.4 Prototyping

Prototyping plans are described in the Technical Management Database available on the EDHS. Of those described, only the ESDIS approved prototypes will be performed, and a subset of those will be released in an Evaluation Package (EP) - those that are user visible or those that support the user visible items. In addition incremental developers may demonstrate prototypes prior to actual EP release in prototyping workshops.

4.2 SDPS EP Strategy

Table 4-1 shows the allocation of the capabilities from the SDPS subsystems described in Section 4.1 that have been selected for development via the incremental track and evaluation via an EP. For some prototypes, it is desirable to obtain feedback prior to its deployment in an EP. Table 4-1 depicts these evaluator feedback mechanisms as Prototyping Workshops (PW1 and

PW2). The Prototyping Workshops will host focused demonstrations and hands-on evaluation of components for which timely feedback is required before their incorporation into an EP.

While it is true that incremental development is founded on the premise that iteration of design through exposure and procedural evaluation by eventual end-users will provide the feedback required for the refinement of those highly visible components, the subsystems delivered incrementally must interface with other components whose implementation cannot be adequately evaluated by an EP. For these subsystems, there exist specific engineering and technical challenges which are best mitigated by deliberate, focused prototypes or studies in order to provide the optimal solution. In addition, the degree to which an incremental component interfaces with or depends upon a component whose risk is managed through prototyping may be sufficient to require that prototyping be completed before the entire capability is submitted for evaluation to end users. The process through which such problems are identified and selected for prototyping is discussed in Section 3. More information on the SDPS Engineering Prototypes is provided in the SDPS Prototyping Plan White Paper (JU9405V1). These prototypes will provide components to an EP, either directly through evaluation package delivery, or indirectly, by feeding into the design of an incremental component.

The EPs will provide increasing capabilities for end user evaluation, and will be a combination of components developed incrementally and selected prototypes. The following subsections will summarize the contents of the EPs in Table 4-1, and describes in more detail the incremental and prototyped portions of each delivery.

4.3 SDPS Content for EP 6

EP6 will provide services from increments and prototypes in the following subsystems:

- EP6, SDPS Increment 1, Client Subsystem
- EP6, SDPS Increment 1, Interoperability Subsystem
- EP6, SDPS Increment 1, Data Management Subsystem
- EP6, SDPS Prototypes, Data Server Subsystem

The major capabilities delivered as Increment 1 in EP6 will be:

1) The Data Visualization toolkit or EOSView (Part of the Client Subsystem)
2) Security services be provided via a CSMS supplied API (Part of the Interoperability Subsystem).
3) Data type services for searching granule and collection metadata, and requests to acquire data.
4) Incremental release of the Advertising service and Interoperability Infrastructure interfaces prototyped in EP4.
5) User self-registration service.
6) Use of the OODCE infrastructure.

Table 4-1. Allocation of Prototypes and Increments to EPs

EP6 TRR 9/95	PW2 12/95	Rel A TRR 4/96	PW2 1/96	*EP7 TRR 5/96	*PW3 6/96	*EP8 TRR 10/96
INC 1 **Client** User Profile and Application Defaults Avertising Service Inventory Search Directory Search Text Search Browse User Registration Help (Menu) **Data management** Data Dictionary **Interoperability** Integration with infrastructure API **Prototypes** **Data Management** Data Server I/Fs (Data Server component of Infrastrucutre) Data Type Services Browse, Acquire, Search Inventory Directory	**Prototypes** **Client** Product Access Processing Request Request/ Results Status **Data Management**	**Client** Product Access Processing Request Request/Result Status Help (Hypertext) **Data Management** Data Type Services Browse Acquire Processing Request Distribution Services Guide Search Text Search **Data Server** Two-Way ECS/Version Interoperability ECS to NOAA Interoperability LIM ECS to Version 0 Interoperability	**Client** User Registration Tool Document Search Tool (V1) ESST Upgrades Product request Upgrade Data Dictionary Upgrades Comment and Survey Modifications Data Acquisition Request Request Status Logging User Preferences Desktop Upgrades Advertising / Earth Pages Upgrades Hotjava **Data Management** LIM Text Search	Production version of PW2	**Client** Remaining functionality for V1 Client Final versions of all the tools in PW2 **Data Management** Remaining functionality for Data Management from PW2 - Data Dictionary LIM Gateway DIM	Production code for the tools and services in PW3

*At the time of this writing, PW3, EP7, EP8 are not officially funded. The information given here reflects future anticipated EP plans.

4.3.1 EP6, SDPS Increment 1, Client Subsystem

For EP6, the Client Subsystem will be composed of a set of X.Motif and HTML application tools collectively named "the Workbench". This partitioning is required at this stage of development to 1) leverage users familiarity and acceptance of WWW viewers, and 2) demonstrate advanced X-windows capabilities currently out of scope for HTML functionality. For those user possessing CDE (Common Desktop Environment), use of the ECS Desktop will be optional.

The Workbench Tools include X-Windows and HTML based tools. The X-Windows based tools are the Earth Science Search Tool, Product Request Tool, EOSView Visualization Tool, and the Desktop Manager. The HTML-based tools are the User Registration Tool, Data Dictionary Tool, Comment/Survey Tool, and User Profile Tool.

4.3.1.1 X/Motif-based Applications

The following tools will be accessed through X/Motif user interface.

4.3.1.1.1 Earth Science Search Tool

This tool will provide the capability to issue a query and retrieve results from the prototype Data Server. It will provide a user-friendly search screen, which does not require typed entry of any attribute values. Instead, the search screen will provide a means for displaying query attribute valid values. For attributes, such as geophysical parameters, which possess extensive valid value listings, a nesting widget will be employed to simplify the selection of the valid values. This widget organizes data hierarchically, allowing them to be conveniently grouped for fast access. For valid values, this facilitates segregation of the valid values into groups which can be accessed independently. There is no limitation to the number of groups which can be nested within one another. Note that domain values for an attribute which are not currently valid will be displayed in greyed-out form.

A timeline widget and a map widget will both be employed to simplify the selection of temporal and spatial ranges. A service invocation user interface will be presented to permit the user to select desired services. Both on-line help and a User's Guide will be provided. All developed source code will be written in C++.

The nesting widget is also used to display query results. Since ECS data collections can be aggregated in many ways and into many levels, the nesting widget is an ideal means of organizing and presenting both collection and granule level metadata. The key concept is the multi-level integration of collection and inventory metadata on a single results window, which obviates the need for separate queries. Data may be dynamically re-aggregated by other than the default aggregation parameters to facilitate speedy and efficient access to the precise data the user wishes to identify. Further, a quick link to the Data Dictionary user interface will be made available to facilitate obtaining definitions of terms.

For EP6, the Search Tool's valid values will be obtained from the Data Dictionary Server, ensuring continuous synchronization of valid values with the current state of the data base.

4.3.1.1.2 Product Request Tool

The tool will be used to confirm granules selected for ordering from the data server. It will manage the submission and confirmation of data orders. For EP6, only ftp delivery of data will be available.

4.3.1.1.3 EOSView Visualization Tool

This tool will be used for displaying available browse images of selected granules in addition to displaying contents of ordered granules. Separate documentation exists to describe the full range of analysis capabilities provided by the software.

4.3.1.1.4 Desktop Manager

The Desktop Manager will be enhanced from the EP-4 version to utilize the nesting widget for the hierarchical and tabular display of desktop objects. This model follows closely that used by Microsoft Windows' and the MacIntosh's file manager.

4.3.1.2 HTML-based Client Tools

The Client will contain a set of HTML-based tools where feasible to implement required capabilities. These tools will be represented by a set of HTML pages along with corresponding shell scripts and server-end code. This will enable these tools to be accessed from popular HTML browsers. A Mosaic browser will be distributed with the Client software, but Netscape is recommended.

4.3.1.2.1 Data Dictionary Tool

This tool will demonstrate the capability to query the ECS acronym list, glossary of terms, and metadata dictionary all of which will be stored in the Data Dictionary Server. Users can look up "vocabulary" via a free text search entry or indexing of catalog. Aliases, Boolean operations, and "see also" function will be supported. Close links to ESST in assisting the construction of a search query will be implemented.

4.3.1.2.2 User Registration Tool

This tool will be the entry point for a non-ECS user to request an ECS account and to obtain ECS client software. An ECS registration form will be provided to obtain user information which includes name, organization, and all the essential data required by the MSS. The registration information will forwarded to MSS for verification and processing. Furthermore, the user will also be allowed to download selected platform versions of the ECS client software to his/her computer.

4.3.1.2.3 User Profile Tool

This tool facilitates modification of user information and ECS application defaults in a user-friendly manner. This information will be stored in the User Information Database which is

controlled by CSMS/MSS. Centralized, remote storage and access of this information will allow context revival (restoration of the users' preferences) on any client to which the user logs in.

4.3.2 EP6, SDPS Increment 1, Interoperability Subsystem

This part of EP6 would come from the Advertising Service Prototype. The Advertising Service is a collection of objects implementing the client subsystem interfaces to the advertising services and representing them on the user interface screen. They include:

- advertisement objects (representing service offers)
- provider objects (representing providers of services)
- data product objects (representing the data products related to the service offers)

These objects will be shown as a combination of HTML pages as well as icons and text.

4.3.3 EP6, SDPS Increment 1, Data Management Subsystem

The Data Dictionary Service (DDS) will provide users with definitions and descriptions of data collections, attributes, keywords, ECS terms, acronyms and glossary. It also provides information on dependent valids. The DDS will use the DDS database, an application server program with an OODCE interface, and CGI scripts for HTTP server access. The application server program receives search requests from the clients, processes the requests and sends the results to the clients. Definitions of data collections, attributes, keywords, etc., can be accessed using the HTML client, HTTP server and CGI scripts. CGI scripts will be used for accessing the data from the database.

There are also several specific objectives that resulted from PW1:

1) Provide aliases for attributes and data collections.
2) Support dependent valids for temporal and spatial search criteria.
3) Support keyword definitions and descriptions without specifying the category.
4) Cleanup the existing data in the DDS database.

In addition, for EP6 new data types will be ingested into the DDS database.

4.3.4 EP6, SDPS Prototypes, Data Server Subsystem

4.3.4.1 Overview

The Data Server Subsystem will provide a limited set of data and services in its EP6 Data Server prototype to support EP6 clients. The following services will be provided: 1) query on metadata for an ESDT, and 2) data delivery for an ESDT.

The query service will be provided for requesters of the inventory (granule) and directory (collection) metadata. The Data Server will accept a search request containing keyword, spatial or temporal constraints and will pass the results back to the requester.

4.3.4.2 Approach

The EP6 Data Server support will be based on the design resulting from the Core Data Server Prototype, scheduled for completion in the Release A CDR timeframe. Most if not all of the EP6 interface requirements (which are in the process of being scoped and designed as of the release of this document update) will be supported directly by Core Data Server Prototype developed software. One such example is the interface to the Public classes currently being designed by the Data Server design team, which will be implemented as distributed objects using OODCE. Modifications will be made to the Core Data Server Prototype as part of its readiness for the EP, consisting of migration of the software to a smaller hardware suite, and the addition of rectangular spatial searching functionality on the inventory. Apart from these modifications, the EP6 Data Server prototype will potentially run unchanged from the Core Data Server Prototype.

4.3.4.3 Data Sets

At present, AVHRR is the data set that the Core Data Server Prototype is basing its design on, and will continue to use to support the EP6 Data Server prototype. Section 6 describes two data sets to be supported by EP6 in more detail.

4.4 Prototype Workshop 2

Evaluation of prototypes from Prototype Workshop 2 will provide input into remaining functionality that will be developed for Release A. Potential prototypes for PW2 are :

Client Subsystem : User Registration Tool, Document Search Tool (V1), Earth Science Search Tool Upgrades, Product Request Tool Upgrades, Data Dictionary Tool Upgrades, Comment and Survey Tool Modifications, ASTER Data Acquisition Request Tool, Request Status Tool, Logging Tool, User Preferences Tool, Desktop Upgrades, Advertising Service/Earth Pages Upgrades.

Also included in PW2 will be a demonstration of CDE support and a Hot Java prototype.

Data Server Subsystem : No support right now for PW2 is planned beyond the capabilities of EP6.

4.5 SDPS Content for EP7*

EP7 will include all of the production code for items presented in PW2 (Section 4.4)

4.6 Prototype Workshop 3*

Evaluation of prototypes from Prototype Workshop 3 will provide input into remaining functionality that will be developed for Release B. Potential prototypes for PW3 are :

Client Subsystem: All of the remaining functionality for V1 Client will be demonstrated in prototype at PW3. This includes final versions of all of the tools and services listed in section 4.4

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* At the time of this writing, PW3, EP7, EP8 are not officially funded. The information given here reflects future anticipated EP plans.

Data Management: All of the remaining functionality for Data Management will be demonstrated in prototype at PW3. This includes the Data Dictionary, LIM, Gateway, and Distributed Information Manager (DIM).

4.5 SDPS Content for EP8*

EP8 would contain the production code for those tools and services demonstrated in PW3. This will allow us to incorporate feedback from the community regarding PW3/EP8 functionality into Release B. If this proves to be unnecessary or not time-efficient, the production code will be included in Release B.

* At the time of this writing, PW3, EP7, EP8 are not officially funded. The information given here reflects future anticipated EP plans.

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5. CSMS Deliveries by EP

5.1 CSMS Development Plan Overview

5.1.1 Introduction

The Communications and Systems Management Segment accomplishes the interconnection of users and service providers, transfer of information between ECS (and many EOSDIS) components, and system management of all ECS components. It supports and interacts with the Science Data Processing Segment (SDPS) and the Flight Operations Segment (FOS).

At its highest design level, CSMS consists of three parts:

- **Communications Subsystem (CSS)**

  CSS is a collection of services providing flexible interoperability and information transfer between clients and servers. CSS services correspond loosely to layers 5-7 of the Open Systems Interconnection Reference Model (OSI-RM).

- **Internetworking Subsystem (ISS)**

  ISS is a layered stack of communications services corresponding to layers 1-4 of the OSI-RM. CSS services reside over, and employ, ISS services.

- **Management Subsystem (MSS)**

  MSS is a collection of applications which manage all ECS resources, including all SDPS, FOS, ISS, and CSS components. MSS directly uses CSS services.

Table 5-1. CSMS Subsystems

CSMS Subsystems	Subsystem Service Superclasses
Communications Subsystem (CSS)	Distributed Object Framework Object Services Common Facility Services
Internetworking Subsystem (ISS)	Data Link and Physical Services Network Services Transport Services
Management Subsystem (MSS)	Management Application Services Managed Object Template Services

5.1.2 Development Track Allocation

The CSS is wholly allocated to the Incremental track. CSS infrastructure capabilities required to support the incremental track will be developed incrementally to provide those services required by SDPS activities allocated to the incremental track or EP prototyping. Additional prototyping

and incremental development will be done to ensure maturing technology is progressing at a pace for required CSS service delivery time frames. MSS may use the incremental track to provide its System Management required for IR1 and Release A. ISS is not planning to do incremental development.

5.1.3 Release Planning/Schedule/Considerations

Table 5-2 provides a characterization of the CSMS Service Superclassess by Release for Interim Release-1 and Release A for the two subsystems to be developed incrementally. This information provides a background for understanding the end point for the incremental build-up of services for Release A.

Table 5-2. Characterization of Service Superclasses by Release

Subsystem Superclass		Major Component	IR-1	A
CSS	**ORB**	Interoperability framework		RPC via OODCE interfaces
	Object Services	Interoperability Services	DCE core services	OODCE core services and Asynchronous Message passing Services
	Common Facilities	ECS-Specific Comm. Services	Heritage applications	Custom APIs on top of Heritage Applications
MSS	**Common Management Services**	Management Framework:	HP OpenView	HP OpenView
	Management Application Services	Fault Performance Accountability Security Trouble Ticketing Physical CM Config'tion MGT Rest	Basic Fault, Performance	Enhanced functionality from IR-1 and the remaining components
	Management Agent Services	Extensible Agents	Native Agents	Extensible Agents

5.1.4 Dependencies (e.g., COTS Selection)

In the CSS subsystem, the key COTS item are DCE and OODCE. DCE is available from several vendors (including a version of DCE for SGI). OODCE is currently available only on HP and SUN. Plans are underway to port it onto SGI and DEC. DCE 1.1 was not introduced to the market as anticipated. Rather, it is expected to be released from the vendors by the end of 1995. It is expected that the corresponding OODCE will be available in another six months (middle of 96). For ORB Prototyping, SUN DOE in early development release will be utilized initially with commercial release expected by the end of 1995. After initial prototyping of DFS and comparing it with NFS, it has been decided to revisit the evaluation of the Remote File Access in Release B time frame. Message passing COTS were evaluated and found that they do not meet the ECS needs. As such, it has been decided to develop Asynchronous Message Passing service on top of OODCE.

In the MSS subsystem, the management services of Data collection, DB and fault require a COTS package. Data collection is provided by custom implementation on top of COTS product (Peer Network's Agent ToolKit). Enterprise Management will be provided by HP's OpenView (for use at least through Release A). Fault management COTS product is TBD.

5.2 CSMS EP Strategy

The overall CSMS EP Strategy is shown in Table 5-3. The table lists the Increments and Prototypes by EP which will be provided by CSMS. EP5 is the delivery vehicle for evaluation of CSMS increment 1, and provides code for IR-1. EP6 is the delivery vehicle for evaluation of CSMS increment 2, and provides code for Release A.

5.3 CSMS Content for EP6

EP6 will provide CSMS services from increments and prototypes in the following subsystems:

- EP6, CSMS Increment 0, CSS Subsystem
- EP6, CSMS Prototypes, MSS Subsystem

5.3.1 EP6, CSMS Increment 1, CSS Subsystem

CSS will provide 3 services in EP6: Directory/Naming, Asynchronous Message passing and Security. All 3 of them are developed under the incremental track. A brief description of these follows.

5.3.1.1 Directory/Naming Extensions

CSS will provide wrapper functions to map some of the XFN functionality to the underlying local namespaces that are supported: Cell Directory Service (CDS) and Global Directory Service (GDS). These wrappers are written on top of the X/Open's standard XDS/XOM interfaces. The wrapper functions allows application programmers to store and retrieve application specific information in the local namespaces.

5.3.1.2 Asynchronous Message Passing

CSS will provide guaranteed asynchronous message passing without any changes at the server side. In this approach, separate threads are formed at the client side to invoke the actual calls to a server. This implementation allows the application programmer to specify the number of tries and the time between each try of the message requests. Internally, it stores the message and retires the specified number of times to send a message. A programmer supplied callback is invoked after successful invocation of the message. If the message cannot be transmitted within the given number of tries, the supplied callback is invoked with a flag indicating the failure status.

5.3.1.3 Security

CSS will provide wrapper functions on top of the OODCE class libraries for the application programmers to specify and use the underlying security mechanisms:

- Authentication - to verify the identity of a principle
- Authorization - to check a principal's credentials to allow access to a service
- Integrity - to make sure that the data in transit is not modified
- Privacy - to make sure that data in transit cannot be revealed.

Most of the functionality in this section will come under Authorization involving creating and maintaining ACLs and ACL databases.

5.3.2 EP6, CSMS Prototypes, MSS Subsystem

For EP6, the Management Subsystem (MSS), will provide four major service areas : User Registration, Management Agent Services, Management Framework, and Trouble Ticketing.

5.3.2.1 User Registration Services

The MSS User Registration Services are responsible for facilitating the creation of user accounts in the ECS system. Requests from the users will be made initially through the User Registration Tool provided by the Client Subsystem. MSS will provide an API call to store the pending applications.

From this point, MSS will provide an HTML interface which will fulfill the following functional areas :

Browse and Process Outstanding Requests - This function will display a list of the pending user account requests. From here, the account may be supplemented with further information and processed. Processing in this case indicates creation of a DCE account and setup of a user profile.

Delete Accounts - This function will allow the existing account database to be queried based on user selection criteria. These accounts can then be removed from the ECS system.

Query Accounts - This function will allow the existing account database to be queried based on user selection criteria. The detail of these accounts can then be displayed.

Table 5-3. CSMS Increments and Prototypes by EP

EP6 TRR10/26/95	REL A TRR 4/96	EP7 TRR 5/96
INC 1 Directory/Naming Extensions Asynchronous Message Passing Security **Prototypes** User Registration Management Agent Services Management Framework Trouble Ticketing	CSS Rel A Services as defined by CSS CDR DID 305 table 4.1-1 MSS Rel A Services as defined by MSS CDR DID 305 table 3.1-1 ISS Rel A Network Services	**INC2** DCE Multi-Cell Deployment Remote File Access (DFS) Transaction Processing Network Management Data Collection Fault Management **Prototypes** ORB Mode Management

5.3.2.2 Management Agent Services

The Management Agent Services are responsible to monitor and control objects with the ECS system. For EP6, the Management Agent Services will provide limited monitor and control ability of several object types. These objects include the various hosts involved in the EP6 as well as the ECS developed application packages.

For application packages, MSS will provide an instrumentation API for integration into EP6 custom software. This API will allow the collection of base performance data such as CPU utilization and memory usage. Additionally the API will provide the ability for remote startup, shutdown, and status checking of the managed applications.

All of the information collected by the Management Agent Services will be available via the Management Framework (see section 4.0).

5.3.2.3 Management Framework (HP-Openview)

The Management Framework will provide a graphical interface to access the data provided by the Management Agent Services. A map of the EP6 network configuration will be the primary interface. From this interface, the collection frequency and other parameters may be configured. After collection, several reporting and graphing options will be provided.

5.3.2.4 Trouble Ticketing (Remedy)

The Trouble Ticketing (TT) provides consistent means of reporting, classifying, and tracking problem occurrence and resolution. For the purposes of EP6, TT will provide an HTML interface which will allow a user to register a trouble ticket. Data contained on this trouble ticket will

include a unique id, a short and long description of the problem, and submitter information (name, phone, etc).

In addition to the HTML interface, TT provides a Motif GUI to the Remedy Package. For EP6, Remedy will be configured to notify specified users upon entry of a trouble ticket, assignment of trouble tickets, and automatic notification of a status change to the submitter. Additionally, the ability to produce reports on the status of all current trouble tickets will be available.

5.4 CSMS Content for EP7*

EP7 will provide services from increments and prototypes in the following subsystems:

- EP7, CSMS Increment 2, CSS Subsystem
- EP7, CSMS Increment 2, MSS Subsystem
- EP7, CSMS Prototypes, CSS Subsystem
- EP7, CSMS Prototypes, MSS Subsystem

5.4.1 EP7, CSMS Increment 2, CSS Subsystem

- DCE Cell Deployment - to mirror planned release B deployment
- Single Sign-on - use of a single sign-on and use of the credentials in all the services dispersed across cells.
- DCE DFS - Provide DFS capability
- Transaction Processing - provide a threads based transaction processing capability for release B.

5.4.2 EP7, CSMS Increment 2, MSS Subsystem

- Network Mgmt - Performance
- Management Services - Data collection, DB, Fault

5.4.3 EP7, CSMS Prototypes, CSS Subsystem

- ORB- continued ORB prototyping with emerging vendor products from IBM, HP and DEC which are being built on top of DCE.

5.4.4 EP7, CSMS Prototypes, MSS Subsystem

- Mode Management - The monitoring and control of various system activities, whether they are functioning sequentially or simultaneously, to ensure that the execution of one activity does not interfere with and is completely independent of the execution of another. These activities include Operations, Testing, and Training.

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* At the time of this writing, PW3, EP7, EP8 are not officially funded. The information given here reflects future anticipated EP plans.

6. Science Datasets and Science Support Scenarios

6.1 Introduction

EP science datasets are samples of science-related data, obtained primarily from the DAACs, to be used in developing, testing and demonstrating EP functionality. The sample datasets are used to populate portions of the EP Data Server to allow realistic assessment of client-data server interaction. Exploration of ECS metadata and browse data structures, however, will require some conversion of existing datasets from the DAAC formats into ECS formats. Candidate datasets are chosen based on the phasing of EP functionality as well as the expected cost to incorporate datasets into the EPs.

Another factor to be considered is the size of the data set. Incorporation of large datasets in the EPs could result in premature purchase of expensive storage. The EP Team working with ESDIS/SDPS representatives determine the phasing of EP functionality and, subsequently, identify and iterate on the candidate datasets.

After functionality and candidate datasets are established for the EPs, established science user scenarios are examined to determine the extent to which they can be realized within the EP functionality. In fact, functionality, datasets and scenarios are all iteratively refined as the incremental design matures, the cost of incorporating datasets becomes better understood, and scenarios are defined with lower level details.

6.2 Dataset Roles and Responsibilities

The ECS EP Team has the responsibility of identifying and requesting from the DAACs sample data and browse products (if available) appropriate for the planned EP functionality. Working together with the DAACs, the ECS EP Team and the DAACs will determine the best approach for transferring the data from the DAACs to the EP Team. Data transferred to ECS for use in EPs will be used for development and test only. Conversion of metadata is the responsibility of the ECS EP Team.

6.3 A User's Perspective on EP6 Capabilities

One factor limiting the range of possible science user scenarios is the EP6 capabilities. The capabilities available with the EP6 Client are summarized in Table 6-1.

In addition, only a subset of the full ECS Core metadata is implemented in EP6. However, sufficient attributes are included to support basic collection and granule level searches and data acquisition. There is no capability in EP6 for the Science Data Server to exchange data with another server, manipulate the data (e.g., transform from one projection to another), modify data or produce new data objects. The present hardware limits the quantity of data for use in evaluations or demonstrations to less than 2 GB, total.

Table 6-1. User View of the EP6 Client Capabilities

Capability	Available in EP6
User Registration and Preferences	Yes
View Advertisements	Yes
Advertisement creation	Yes
Look up Terms in Data Dictionary	Yes
Search and Access Documentation	No document data server. This will be provided via hot links to WWW documentation pages, for guide-level documents (in lieu of document server).
Search for Science Data	Spatial searches only by bounding coordinates, cannot include pole in interior or cross the international dateline.
Obtain Browse	Yes, but thumbnails not supplied
View Browse Product	Yes
Order Science Data	Delivery via ftp, only
Subsetting	No
Subsampling	No
Acquire tool	Yes
Integrate tool with Desktop	Yes
Enter Subscriptions	No
Distributed Query/Access	No DIM
Site Query/Access	No LIM
On-line Help	No
Interoperability with V0	No

6.4 Science Data Availability

Another factor limiting the range of possible EP6 science user scenarios is the availability of suitably formatted data and associated metadata. The decisions with regard to data require iteration with the range of science scenarios that can be supported by EP6.

6.4.1 EP6 Data Needs

Data is needed for EP6 to support the provided services. These include:

Advertising Service: Dataset descriptions that include the EP6 inventory.

Data Dictionary: Definitions of terminology.

Search Services: A subset of the ECS Core Metadata for inventory-level information.

Browse Service: Browse products for the inventory data.

EOSView: Sample data in HDF to demonstrate EOSView functionality.

6.4.2 V0 Data

The DAACs have a variety of readily accessible data which can potentially be used in developing, testing and demonstrating EP functionality. An effort to migrate selected V0 data into ECS formats is in the early stages, and a potential data source for later EPs. Sample granules of these data will not be available for EP6. The V0 data migration effort includes data reformatting, metadata reformatting, metadata generation, browse reformatting/generation, supporting documentation and additional material needed to use the data.

The coordination of data migration needs of EP6 with the larger V0 data migration efforts is desired to minimize expended efforts and to share the lessons learned. In view of the larger V0 data migration effort, some considerations in selecting V0 data to be acquired for EP6 include the effort needed to:

- Convert data format to HDF.
- Generate a browse product.
- Establish the collection level and granule level metadata for EP6.
- Create Advertisements and Data Dictionary Entries.
- Establish guide information or references.

6.4.3 Future Data Needs

An additional consideration in selecting data for use with EP6 is the possibility for supporting evaluations/demonstrations of future EP capabilities (e.g., subsetting). The potential for using the data for system integration and test of ECS should also be a consideration for selection.

One consequence of these considerations is that the full data resolution should be acquired rather than requesting that the DAAC perform subsetting or subsampling. If storage of the full data is not possible with the EP6 Science data server, then strategies of limiting the number of available granules should be employed.

6.4.4 Candidate Data Sets

Examining the V0 with the above considerations in mind, and looking to the science scenarios that can be supported by EP6, three candidate data sets have been identified. These data sets and some relevant characteristics are listed in Table 6-2.

The 1km AVHRR data are available on-line from the EDC DAAC. While not in HDF, the necessary code to convert these data has already been written and tested as part of the V0 data migration effort. The associated metadata is already available, and was used in PW1. These data also support the science scenario described in Section 5.1.

The ERBE and ISCCP data are available on-line via the LaRC DAAC IMS. However, the ERBE SG4 and the ISCCP C2 data are the only data which are already in HDF. The V0 metadata for these data are adequate for EP6, requiring no additional effort to collect. These data also support the science scenario described in Section 5.2.

Table 6-2. Some Candidate Data Sets for EP6

Data Set	Spatial Coverage	Temporal Coverage	No. of Granules/ Size (MB)	Browse (MB)	Format	Source of Data	Source of Metadata
AVHRR, 1 km, 10-day composite NDVI	North America (L3)	Apr92 - Mar93	36/135 [1]	TBD[2]	Raster Image [3]	EDC	PW1
ERBE SG4	Global (L3)	Jan85 - Dec90	64/ 12.8	0.8 [4]	HDF	LaRC	V0
ISCCP_C2	Global (L3)	Jan85 - Dec90	60/ 4.4	None	HDF	LaRC	V0

Notes: 1 - Can be compressed by a factor of 10:1
2 - If not available, a browse product will be created by subsampling product granules.
3 - Code already written to convert to HDF. This has been done as part of the V0 pilot migration effort.
4 - Some granules have browse products

6.5 Science User Scenarios

Through prior work with the scientific community, the ECS User Modeling efforts, identified and elaborated 27 user scenarios, representing the manner in which both the system and the data will be accessed. An analysis of these scenarios can be found in *User Scenario Functional Analysis* (194-00548TPW). The advantages of building on this baseline of science user scenarios include:

- Maximizing the return from previous efforts
- Employing a stable reference for assessing incremental enhancements of EP and ECS capabilities

Two of these established user scenarios can be realized within the EP6 functionality, with relatively minor adjustments to these scenarios. These scenarios incorporate sufficient richness to be useful for evaluating future EP capabilities.

6.5.1 Scenario 1: Monitoring of Sugarland Run Watershed

In this scenario, number 6 of the 27, the investigator (Jerry Garegnani) wants to determine correlations between land use patterns and water quality of Sugarland Run, a Potomac river tributary. This involves building a database documenting changes within the watershed, including vegetation over the course of the growing season.

As written, the scenario involves MODIS, ASTER and Landsat-7 data, as well as a one-time order of DEM data. The main adjustment of this scenario, delineated in Table 6-3, is the use of 1 km AVHRR-derived NDVI for North America.

Steps involving browse of selected data have been added to the original scenario. Also added are steps involving an advertised tool for determining Precipitable Water Index (PWI). The variation in PWI has recently been shown to have an effect on NDVI values for the same vegetative condition comparable or larger than those of variable aerosols and surface emissivity.

6.5.2 Scenario 2: Obtaining Information/Data for a Review Paper

In this scenario, number 13 of the 27, the investigator (Bruce Barkstrom) wants to prepare a review paper about the Earth Radiation Budget, including recent developments of the ECS instruments. As written, the scenario involves CERES data, as well as bibliographic references.

The main adjustment of this scenario, delineated in Table 6-4, is the use of ERBE and ISCCP data.

Table 6-3. Science Scenario: Monitoring Sugarland Run Watershed

	Step	Aspects Requiring Future Capability
1	Starts Client and connects to EP6	
2	Start ESST, specifying search criteria: • NDVI • Upper Left: 40 N, 78 W • Lower Right: 39 N, 77 W • Yearly: 1 April - 30 September	Additional types of data that the investigator would like to search are: • land cover classes • land surface reflectance values
3	Examine the search results	
4	Select products for browse and initiate transfer: (AVHRR 1 km, North America 10-day composite NDVI) (This step has been added to the original scenario.)	
5	Visualize browse data with EOSView. (This step has been added to the original scenario.)	
6	Select products for order: (AVHRR 1 km, North America 10-day composite NDVI for April - September 1992)	Investigator would like to have the data sets subsetted and sent via ftp.
7	Submit and confirm order.	
8	Locate guide documents via advertising service, and examine. (Using URL for appropriate EDC WWW page in place of the Document Data Server)	
9	Exercise data dictionary service to clarify usage of term (e.g., NDVI)	
10	-	Establish a standing order for the selected data to be subsetted and sent via ftp and CD-ROM
11	Discover advertisement for tool to compute Precipitable Water Index (PWI). Variation in PWI will influence NDVI values computed for the same vegetative condition. (This step has been added to the original scenario.)	
12	Download PWI tool from referenced ftp site, and installs on Desktop (This step has been added to the original scenario.)	
13	Modify search criteria to determine availability of related data for computing PWI: (AVHRR channels 4 and 5)	Investigator would like to check on availability of: snow cover data, digital elevation data, soil type data
14	Request additional guide information on AVHRR Channels 4 and 5. (Using URL for appropriate EDC WWW page in place of the Document Data Server)	
15	Select products for order: (AVHRR 1 km, North America 10-day composite channels 4 and 5, April - September 1992)	
16	-	Establish another standing order for selected data to be subsetted and sent via ftp and CD-ROM.

17	Log out from EP6	

Table 6-4 . Science Scenario: Information/Data for Review Paper

	Step	Aspects Requiring Future Capability
1	Starts Client and connects to EP6	
2	Start ESST, specifying search criteria: • LW, SW radiative fluxes, albedo • July 1989	
3	Examine the search results	
4	Select products for browse and initiate transfer. (ERBE_SG4, ISCCP_C2)	
5	Visualize browse data with EOSView.	
6	-	Investigator would like to obtain only the SG4 values for the cloudy regions, since he desires only the cloud forcing values.
7	Select products for order via ftp. (ERBE SG4 and ISCCP C2)	
8	Submit and confirm order.	
9	Locate guide information for algorithms via advertising service, and examine. (Using URL for appropriate EOS Science Office WWW page for ERBE ATBDs in place of the Document Data Server)	
10	Exercise data dictionary service to clarify usage of term	
11	Copy the desired algorithm description via ftp.	
12		Investigator wants to search for and inspect relevant reference papers in the Document Data Server
13	Modify search criteria to determine availability of related data: (Net Surface Radiation, January 1989-July 1990)	
14	Select products for order via ftp. (ERBE SG4)	
15	Submit and confirm order.	
16	-	Modify search criteria to determine availability of Synoptic data, containing instantaneous field characteristics. These correlations are examined using a regression analysis.
17	Log out from EP6	

6.6 Prototype Workshop Science Support Scenarios

A subset of the EP6 science support scenario was utilized for PW1. For PW 2, an end-to-end scenario will be created for a few products to provide the user the "look and feel" of services from advertisement through request status services.

7. Intersegment EP Interfaces

Interfaces between CSMS and SDPS for EP6 are listed in Table 7-1. The table is organized by CSMS Subsystem, Service Superclass and Service Class. The majority of the interfaces are with the CSS subsystem. Table 7-1 is built using Table 6.3.4-1 in the System Design Specification (194-207-SE1-001). Table 7-1 lists only those CSMS service classes which will be available for Release A. The CSMS EP Plan column describes in what fashion each service class will be developed. The SDPS interface column lists how SDPS will make use of the CSMS provided service classes.

Descriptions of the service classes are available in the System Design Specification.

Table 7-1. Intersegment EP Interfaces by CSMS Subsystem

CSMS Sub-System	Service Superclass	Service Class	CSMS EP Plan	SDPS Interface
CSS	DOF	IDL	OODCE IDL++	All applications for defining distributed objects
CSS	Object Services	EventLog	DCE API	All applications for logging events
CSS	Object Services	Naming	Directory service + encapsulation of XDS/XOM interfaces for the Directory and Naming service	All client applications to bind to server objects
CSS	Object Services	Security	Encapsulation of OODCE Security	All distributed objects
CSS	Object Services	Threads	OODCE Threads	All server applications within CSS Asynchronous message passing service
CSS	Object Services	Time	DCE Distributed Time Service	not applicable
CSS	Object Services	Asynchronous Message Passing	A custom layer on top of OODCE	Acquire Notifications from Data Server
ISS	(multiple services)	(multiple services)	As required to support EPs	Data Transport and OS Access
MSS		Trouble Ticketing	HTML and Remedy	HTML is used by end user Remedy is used by M&O
MSS		User Account Management	HTML and custom implementation on OODCE	Used by M&O
MSS		Management Agent	Custom implementation on OODCE	not applicable (MSS internal use only)
MSS		Management Framework	HP OpenView	used by M&O

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8. EP Integration and Test

8.1 EP I&T Process Overview

The EP Integration and Test (I&T) process focuses on proper functional integration as well as fault elimination from each EP release. I&T is performed on EP software before it is deployed outside of ECS contractor control to assure an appropriate level of stand-alone robustness. (Note that Prototype Workshops do not require the I&T described in this section because they are not deployed.) Various test and validation techniques are implemented to provide an effective process in finding and eliminating faults. Typically, the faults associated with an EP release can be categorized as follows:

a) Functional - in terms of the available user tasks and products;

b) Interfaces - between applications, networks, DCE, protocols;

c) Performance - utilization of resources over the distributed network.

The development and integration of EP components is part of the incremental ECS track. As such, the iterative development cycle requires a decrease in the documentation. In spite of this, the tailored EP I&T process as described herein will provide effective validation for each EP release. In addition, the ECS Quality Assurance (QA) and Configuration Management (CM) groups will assist the EP I&T team in the following areas:

QA

- Assistance in reviews and inspections (code, test plans, test reports, etc.);
- Collection of process metrics;
- Assistance in NCR tracking;
- Test witnessing (when appropriate);

CM

- Configuration Management control.
- Build software for test execution and deployment.

The EP I&T team integrates separate incremental components and selected prototypes into an end-to-end system able to perform Evaluation Package functions. Initially, the Development organization performs early integration of low level components with the I&T organization's support and coordination. The integration and testing is performed based on the build/thread plan documented in Section 8.3. The EP I&T organization works with the Development organization to complete testing based on the EP I&T Procedures (Section 8.4). The Development organization is responsible for assisting in problem diagnosis and for correcting software problems. The EP I&T organization is responsible for running the tests, documenting problems detected, verifying fixes, and writing the EP I&T Report at the completion of the tests. The

results of the Integration and Test stage are documented in a series of folders (see Table 8-1). Figure 8-1 depicts the EP I&T process .

Upon completion of the increment integration and test activities, an EP Readiness Review is held initially with program management. The EP I&T Report is reviewed and open problems (associated with failed test cases) are evaluated. EP management and developers must concur that capabilities left out of the EP are acceptable before the EP integration and test stage is considered complete.

8.2 EP I&T Organization

During each EP development cycle, an inter-segment team is formed that includes members from the various ECS development and test organizations (Figure 8-2). The EP I&T team may contain members of the Release A and B I&T organizations as well as the IATO organizations. Table 8-2 describes the roles each of these team players have in the EP I&T effort. The tailored EP I&T process consists of a subset of test and integration phases from the formal track. In general, EP I&T efforts will address the areas listed in Table 8-2. More specifically, the segment developers will be responsible for the unit level tests, while the EP I&T team will focus on system level functional, interface and performance tests on those components that have been integrated.

Table 8-1. EP I&T Roles

Players	Test Type				
	Component Integration & Unit Tests	Functional Tests (Threads)	Integration Tests (Builds)	System & Performance Tests (Scripts)	Usability Testing (Scenarios)
Segment Developers	Responsible				
EP I&T	Assist	Responsible	Responsible	Responsible	Assist
EP Evaluation Leader					Responsible

8.3. EP Build/Thread Plan

The build/thread concept, which is based on the incremental aggregation of functions, is used to plan the EP I&T effort. A thread is the set of components (software, hardware, and data) and operational procedures that implement a function or set of functions. Threads are tested individually to facilitate requirements verification and to isolate problems. A build is an assemblage of threads to produce a gradual buildup of system capabilities. Builds are combined with other builds and threads to produce higher-level builds. Verification of threads and builds is accomplished at progressively higher and higher levels as the EP is assembled.

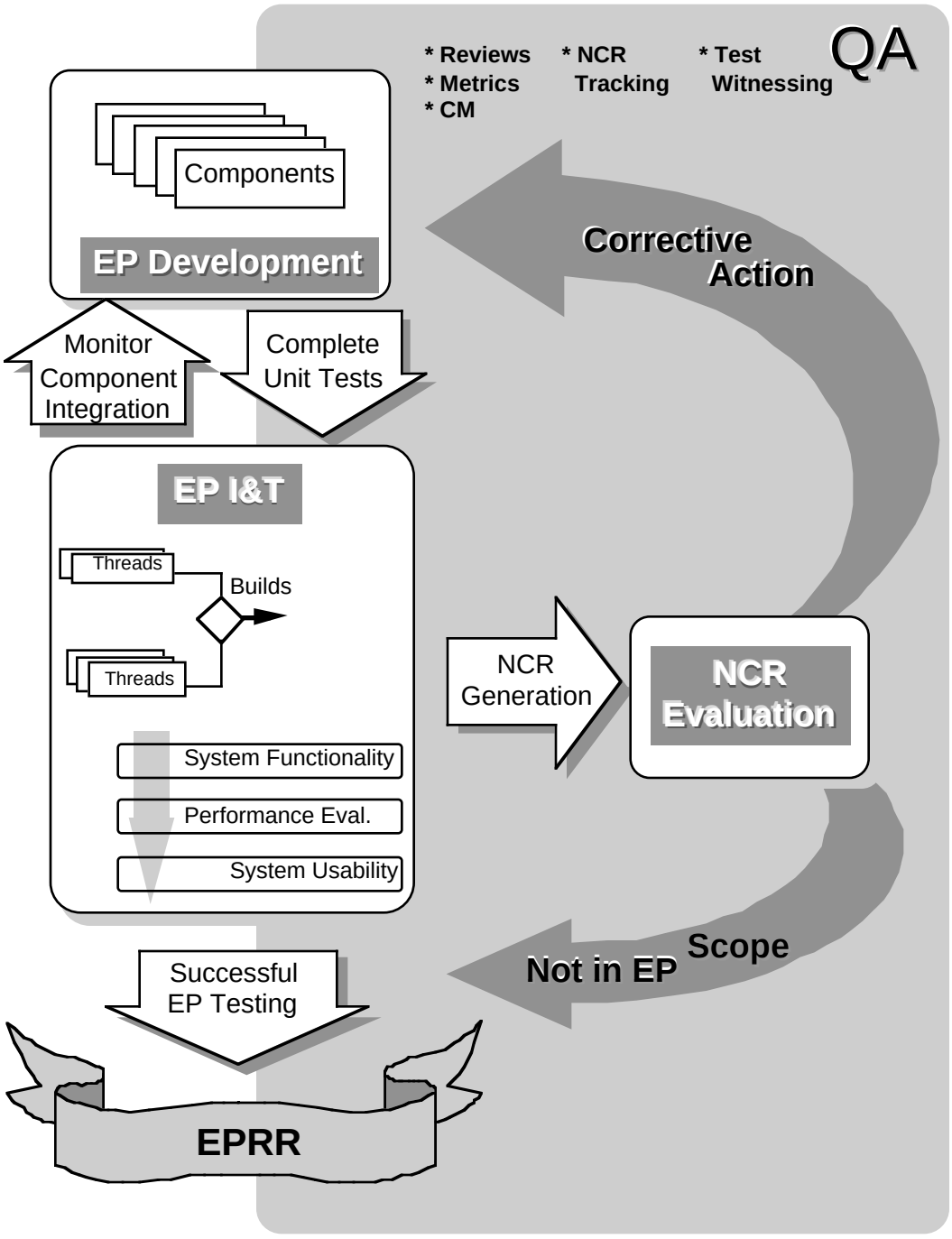

Figure 8-1. EP Integration and Test Process

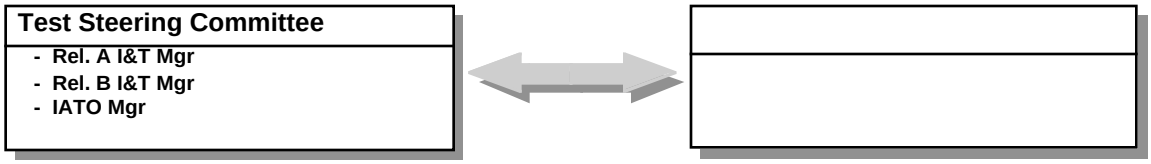

Figure 8-2. EP I&T Team Organization

The build/thread process allows I&T to occur in parallel with EP development. As components are developed and pass unit tests, they are integrated into threads and subsequent builds. Regression testing of previously integrated components occurs at each build integration to verify the evolving EP components operate as a cohesive product.

The Build/Thread plan for an EP is developed as part of the EP/Increment I&T Plan. Typically, EP builds and threads account for a subset of the overall functionality as provided in the ECS Builds and Threads described in the System Integration and Test Plan for the ECS Project (194-402-VE1-001).

8.4 EP Test Plans and Procedures

The EP Test Plans and Procedures document will provide the following information:

- Test Overview - breakdown of the actual tests to be performed (typically a functional breakdown)
- For each test outlined in the overview the document will provide:
  - Test Objectives
  - Test Resources
  - Dependencies (if any)
  - Test Cases
  - Test Procedures for each Case

The actual detailed test case procedures will be provided as part of the EP I&T Test Report. These procedures will be comprised of two parts, one being a script developed and maintained using the ECS Capture/Playback Test Tool. The second is in the form of test operator instructions for the test case configuration setup and execution.

Table 8-2. Integration and Test Documentation

Folder Name	Folder Description
EP I&T Report	A report is developed for each EP to identify results of the increment testing. Capabilities successfully tested and capabilities failing testing (and a justification for removing the failed capability from the increment) will be documented. Responsible organization: EP Integration and Test
Development Notebooks	Supporting material describing problem fixes are documented in the existing Development Notebook folders. Responsible organization: Development
Non-Conformance Reports (NCRs)	Problems identified during integration and test are documented in a problem report data base as Non-Conformance Reports (NCRs). The status of NCRs (e.g. open, assigned, closed) and other information are stored and provided to EP reviewers at status reviews. Responsible organization: Integration and Test.

Test cases will be written to exercise both custom code and COTS packages. Through the use of the ECS Capture/Playback Test Tool, single-user emulation tests will validate specific functionality while multi-user emulation will provide accurate and repeatable system load and performance tests. The ECS Capture/Playback Test Tool used is XRunner by Mercury Interactive Corporation. Mercury Interactive Corporation's Loadrunner test tool will be used to accomplish performance testing. Demonstration scripts (e.g., as a precursor to the Usability Tests) will also be generated using the XRunner tool.

A number of tools will be part of the EP I&T process:

(i) ClearCase Configuration Management;

(ii) Requirements Traceability Management (RTM);

(iii) DDTS for NCR tracking;

(iv) Single and multi-user Capture/Playback Simulator for functional and performance tests;

(v) OpenView Management Framework;

(vi) Instrumented applications (e.g., APIs) as well as custom and COTS log files (e.g., history logs);

(vii) Network Analyzer.

Items (iv) through (vii) listed above will be used in the EP performance evaluation tests. The objectives for these tests is to establish a baseline for the EP network response time under various conditions. For example, network load factors, packet sizes, protocols, and bandwidths will be monitored for transfer rate analysis of various file types and sizes. These evaluations will contribute to the overall understanding of the prototype networks and their relation to the transfer protocols used.

8.5. EP Test Non-Conformance Tracking

Once developed components are integrated, the EP I&T team will conduct tests defined in the Build/Thread plan that address the EP functional objectives. The EP I&T process will then provide feedback to the developers through the recording and tracking of discrepancies - Non Conformance Reports (NCRs) - during testing. Since the EPs are focused on particular functionality, an assessment of each NCR is made to determine whether it will be corrected within the current EP release. The impact of the error on the EP objectives is the prime consideration in this assessment. In addition, a distinction will be made between NCRs recorded against increments versus those recorded against prototypes. Since the latter are only partially applicable to the EP functionality, only those prototype NCRs directly related to the EP integration will be tracked. Prototype developers will be informed of the detected problems. The EP Test report will document any known discrepancies in the delivered product.

Table 8-3. Sample NCR Tracking Form

NCR ID #: Test Priority: Test Case Name: Submitted By: Entry Date:	Status: ❍ Open ❍ Closed ❍ Fixed ❍ Duplicate ❍ Withdrawn Priority: ❍ 1 ❍ 2 ❍ 3
Problem Title:	
Problem Description:	❍ Increment ❍ Prototype

Table 8-4 Non-Conformance Report (NCR) Procedure

(T0 Time of problem)	**PROBLEM DETECTED** • Enter the NCR (Developer or I&T) • The NCR tool will notify the developer of the problem, when it is submitted, by electronic mail.
(T1 Next Morning)	**NCR REVIEW (Daily)** • An updated NCR list will be distributed containing all new and updated NCRs from the previous morning. • Originator will describe new NCRs. • Group assesses validity of problem. • Determine Corrective Action if known and estimate of the time to fix. • Group assigns priority. • After meeting, QA updates status of NCRs (priority, risk, status, etc.).
(T2 T0 + 1-3 days)	**BUILD** • Developer Makes Fix • Developer Indicates Action Taken to correct fixed NCR on form. • The NCR tool will notify I&T when the developer updates the NCR status to fixed. • CM will re-build software with direction from I&T. • All Fixed NCRs documented with corrective action.
(T3 T0 + 4 days)	**RETEST** • I&T Retest for Problems • Regression Test of Affected Components • Results discussed at the next NCR Review.

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9. EP Resources

9.1 EP Resources Overview

An overview of EP Resources is shown in Figure 9-1. These resources were used to deploy EP4. No major additional resources are required for EP6

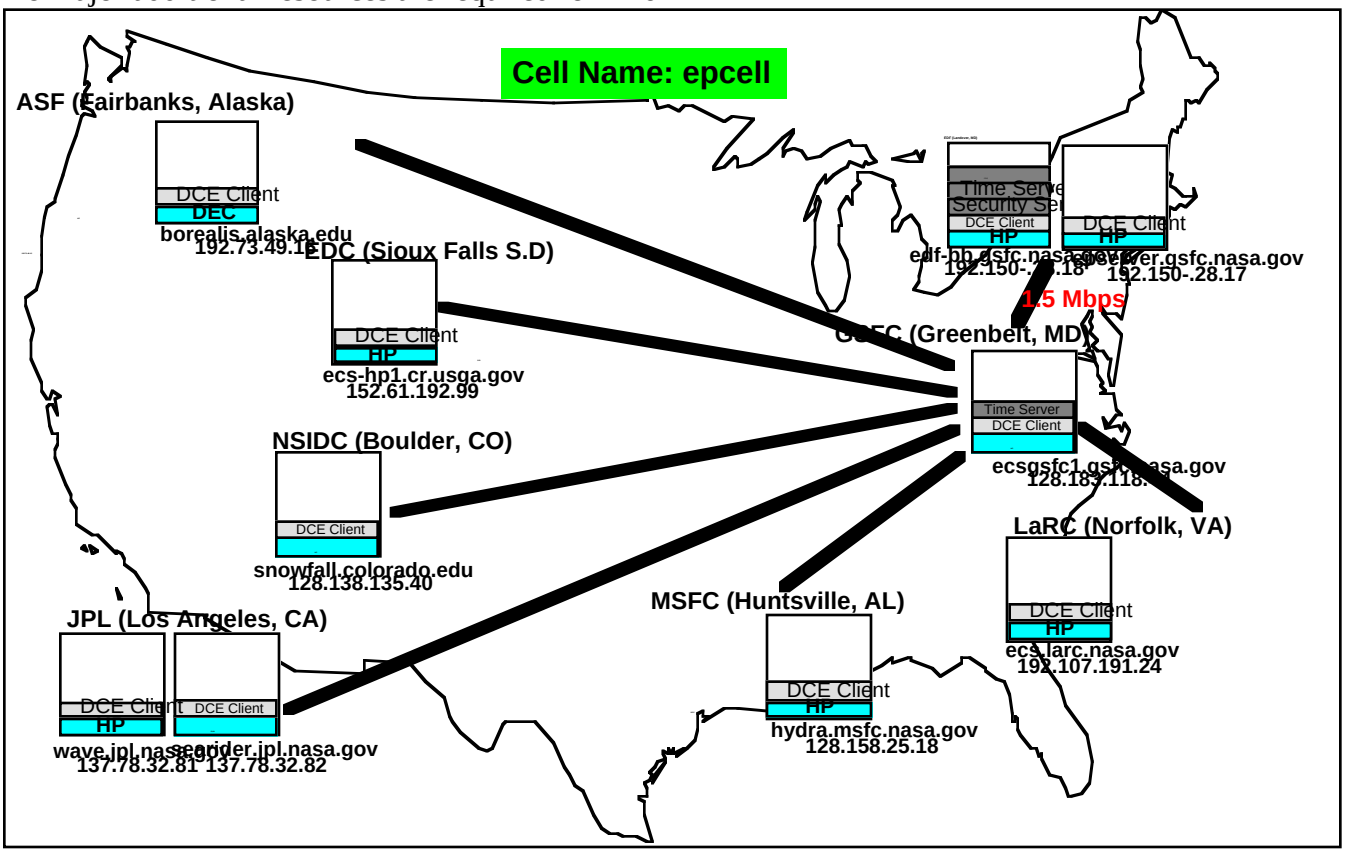

Figure 9-1. EP Resources Overview

9.2 EP Workstations

The main resources for EPs are workstations at the EDF and the DAACs (Table 9-1). The configuration of these workstations is governed by ECS Development Facility (EDF) Policies and Instructions (ECS PI SE-1-002 Draft). These workstations are also used by the ECS DAAC Liaisons for additional purposes.

Table 9-1. EP Workstations

Node	IP Address	Model	OS Version	Location
ECS	192.107.191.24	HP 715/50	HP UX 9.05	LaRC
ECS-HP1	152.61.192.99	HP 715/50	HP UX 9.05	EDC
ECSGSFC1	128.183.118.44	HP 715/50	HP UX 9.05	GSFC
EDF-BB	192.150.28.18	HP 715/50	HP UX 9.05	EDF
EPServer	192.150.28.17	HP 735	HP UX 9.05	EDF
Hydra	197.107.196.75	HP 715/50	HP UX 9.05	MSFC
Searider	137.79.32.82	SUN Sparc10/40	Solaris 2.4 (SunOS 5.4)	JPL
Snowfall	128.138.135.40	HP 715/50	HP UX 9.05	NSIDC
Trouble	137.229.37.51	HP 715/50	HP UX 9.05	ASF
Wave	137.79.108.188	HP 715/50	HP UX 9.05	JPL

9.3 Networks for EPs

Data communications needs fall into two categories:

- Users will access the Evaluation Package via the V0 network and/or the NASA Science Internet (NSI), a TCP/IP-based network within the Internet. Some users may need to be granted access to NSI.
- A dedicated V0 link connects the EDF and the GSFC campus network, for EP access to the V0 network and the NSI. The link includes the transmission medium itself, terminating multiplexers on both ends, and an interface unit (e.g., bridge or bridge-router) at GSFC.

9.4 Science Data

Science data to be used in EP evaluations are described in Section 6. These data are located on the EP Data Server at the EDF.

9.5 Coordination of EP and Formal Release COTS Procurement

COTS hardware from EP5 will be sufficient for EP6. COTS Software beyond that procured for EP6 has already been purchased. The software used in EP6 is listed in Table 9-2.

Table 9-2. EP6 Software

	Version
DCE	1.0.3
OODCE	on DCE 1.0.3
C Native compiler	3.x
C++ Native compiler	4.x
Sybase	10.0.2
Rogue Wave C++ tools	1
Rogue Wave DB tools	1
Clearcase	2.x
HTML Server	2 (w/Netscape Extensions)

For future EPs, procurement will be consider in light of COTS procurement for the Formal Releases. COTS Procurement for Formal releases follows dates as recorded in the ECS Level 1 Master Schedule. A summary of those dates in recorded in Table 9-3.

Table 9-3. Formal Track COTS Procurement Dates

	IR-1	Release A
COTS Requirements Defined	11/94	7/95
Final PO Release	5/95	9/95
Final HW/SW Delivery	8/95	TBD
COTS HW/SW Installation	11/95-12/95	TBD

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10. Evaluation Process

10.1 EP Evaluation Approach

Evaluation Packages are used to make selected functionality available for evaluation and to assist in the refinement of the implementation of that functionality. EPs will be evaluated on their ease of use and user satisfaction, by means of: Usability Testing, the Comment Survey Tool (CST) and Application Program Interface (API) Evaluation. The usability tests are conducted in a controlled environment that allows for observed and measured response during evaluation of design efficiency. The Comment Survey Tool is an on-line survey tool that collects user preferences and suggestions. This survey is available to evaluators within the bounds of the defined Evaluation Period. API evaluation will focus on the design, compilation, and use of Application Program Interfaces within the EP framework.

Several user groups will participate in EP evaluation: Science users, Operations and User Services personnel, and ECS Developers. These different groups were chosen because they may be accessing the EPs for different reasons, and will require different EP functionality to suit their needs. Each user group will be asked to test the various EP features and capabilities at different stages in EP development.

During the course of the Evaluation Package development there will be a variety of combinations of evaluation methods and user groups (Table 10-1).

Table 10-1. EP Evaluations

EP Event	Evaluation: Method and User Group
EP6	Usability Testing, Science Users Survey, Science Users Usability Testing, Operations and User Services Survey, Operations and User Services
PW2	Usability Testing, Science Users Survey, Science Users Usability Testing, Operations and User Services Survey, Operations and User Services
EP7	Usability Testing, Operations and User Services Usability Testing, Science Users API Evaluation, Science Users (TBR) Survey, Science Users Survey, Operations and User Services

10.2 Evaluation Methods

10.2.1 Usability Testing

The usability test will evaluate the efficiency of the user interface designs of the EP components. These include: EP user interface mockups, user data search specification, data browse, and animation functions. Developers are involved in the usability test as observers to obtain first-hand reactions to their products. The data from the tests are compiled, analyzed and then presented to developers where they are used to improve the user interface (in the designs of windows, layout of screens, buttons, selection parameters, window hierarchies, and help messages).

Pretest Preparation

Test Environment: The tests are conducted in the ECS Development Facility (EDF) in a controlled-environment that mimics the environment of a typical user. Test Participants (representative end-users) are selected from the available NASA evaluators, also known as “Tirekickers”, representatives users from the larger science community, DAAC users and User Services personnel. A Facilitator will coordinate the test and a Timer will be present at the test session to note the time for each test task. Members of the Development team will be invited to observe the usability test sessions. To ensure a standard test environment and to avoid hardware biases, all usability tests will be conducted on the same machine, under similar system load.

Task Definition: A series of simple tasks will be defined such that, when these tasks are executed successively all the mocked up user interface capabilities of the EP are tested. The tasks are defined to allow the Participant to evaluate significant portions and capabilities of the EP.

Metric selection: For each task a number of metrics are measured; a)Time-to-Perform and b) user satisfaction rating (usability index). If resources allow, c) error rate and d) task retention are measured.

Test Participant Selection: Participants with a wide range of experience and various levels of exposure to the EP are selected. For example, the Science user group Participants will include scientists who are familiar with the concepts of the EP features being tested but will be using the EP for the first time, scientists with some familiarity with the EP, and Scientists who have used the EP several times. In addition, Operations and User Services personnel, as well as, API Developers and users will be asked to test the EPs for usability. These groups will use the EPs in different ways and will require a system adapted for their needs. To determine a baseline, or "best time" score for completing each task to measure the effectiveness of the user interface, the EP developers will be participating in the usability testing.

Usability Testing Sessions

Participant briefing: Before the commencement of the test, the Participants are briefed about the goals of usability testing and the test procedures. It is emphasized to the Participant that the purpose of the test is to test the usability of the software and not the

Participant, or their use of the software. The Test Participant is encouraged to comment aloud as they execute each task and after the completion of each task.

Usability test: The usability test will last about an hour. The Participants are given one task at a time, and the Timer will note the start- and end-times for each task. Any comments that are made by the Participant are noted by the Facilitator. The developers, who are observing the testing sessions, will watch for problems and opportunities for improvements and note them.

At the end of the test the Participants are requested to complete an Exit Survey that summarizes their experience testing the software and contains questions relating to each task and portion of the EP. The Exit Survey also asks Participants about their previous computer experiences and computing environments.

Data Compilation and Reporting

The synthesized metrics, the results of the Exit Survey, the analyses, the user comments, the potential usability trouble areas, and the recommended changes are compiled in a report. (Reference 4.2.3.2.3) A report will be published after each formal EP review. After the workshops a less formal compilation of results and any statistics collected will be made available.

Usability Testing (UT) Roles and Responsibilities

The EP Evaluation Team consists of the organizations and functions responsible for fulfilling the usability testing roles indicated in Table 10-2.

Table 10-2. Usability Testing Roles and Responsibilities

Name	Evaluation	Data Analysis/Report
Developers	o Consult on UT use/design o Participate in UT	o Provide observation note to UT data analysts
Integration & Test	o Consult on UT use and test findings	-
ECS DAAC Liaisons	o Consult on use o Help identify UT Participants	o Assist with understanding of inputs/methods/participation
EP Evaluation Leader	o Conduct Usability Test as Facilitator o Data recording	o Data collection and analysis o EP Evaluation Report prep lead
ECS Configuration Management Office	o Maintain EP Baseline	o Maintain EP Baseline
ECS M&O Office	o Help Desk o EP System Admin. Support	o Help Desk o EP System Admin. Support

10.2.2 Comment Survey Tool (CST)

The Comment Survey Tool is an on-line survey tool that allows evaluators, who are not evaluating the EPs in Landover, to register their comments about the EPs . The CST contains questions about the EP capabilities, applications, interface design, and performance. In addition to questions, a free-text comment field is provided for evaluators to enter any and all comments

they have about the EP, the survey, and their evaluation experience. Evaluation responses are written to a database which is queried by data analysis personnel to gather and analyze evaluation input.

Evaluator Selection

Evaluators for EP are designated by ESDIS, and DAAC managers at ESDIS invitation. Their expertise includes earth science, engineering, V0 development, and User Support. Additionally, the V0 Science Advisors have been invited to evaluate EP to lend their special perspective to the evaluation.

Evaluator Familiarization

Evaluators will be given a demonstration of EP functions and methods of operation at the start of the Evaluation Period. Also, the evaluators will be given an EP Evaluator Brochure and will be able to consult with a local ECS liaison as needed.

Evaluator Exercise of EP

Evaluators are free to explore all facets of EPs and are encouraged to make input of free-text comments on any or all aspects using the CST and the EP. They are requested, however, to execute a series of tasks, similar to those used in usability tests at least twice during the evaluation period recording their impressions by answering all questions on the CST survey each time. The two executions of the tasks should be separated by at least a week.

CST Data Extraction

Evaluator comments and survey responses will be retrieved weekly during the Evaluation Period by EP data analysis personnel. All responses will be held confidential by the data analysis organization unless a release form is completed by the evaluator. The release form allows development personnel to contact the evaluator to explore implementation preferences indicated by their comments or to clarify their meanings.

Data Compilation and Reporting

Responses retrieved from the database are analyzed. Those evaluators who have signed releases may be contacted at this time for more information or clarification of their comments. The results from this data analyses are incorporated into the EP Evaluation Report in conjunction with those results from the usability test.

EPs Roles and Responsibilities

The EP Evaluation Team consists of the organizations and functions responsible for fulfilling the EPs roles indicated in Table 10-3.

Table 10-3. EPs Roles and Responsibilities

Name	Evaluation	Data Analysis/Report
Developers	• Consult on CST use/design	-
Integration & Test	• Consult on CST use and test findings	-
ECS DAAC Liaisons	• Evaluate and take CST Survey • Familiarize remotely located evaluators with EP • Fault resolution	• Assist with understanding of inputs/methods/participation • Coordinate evaluator participation • Consult on EP process
DAAC EP Evaluators	• Receive familiarization from Engineering Liaison • Evaluate and take CST survey	
EP Evaluation Leader	• Consult on CST design	• Data analysis • EP Evaluation Report lead
ECS Configuration Management Office	• Maintain EP Baseline	• Maintain EP Baseline
ECS M&O Office	• Help Desk • EP System Admin. Support	• Help Desk • EP System Admin. Support

10.3 Evaluation Groups

10.3.1 Science users

Selection of the appropriate users for each user group is important in order to insure that the results of usability testing, CST Survey, and the API evaluation are robust. Those who will be selected to participate in EP evaluation as Science users will hail from a variety of earth science backgrounds with varying levels of experience with the EPs. NASA representatives, the DAAC Engineering and Science Liaisons, and other scientists will be asked to provide a list of Science User group candidates. A core group in the Science users category are the “Tirekickers.” Science users will be evaluating both the user and API interfaces to ECS.

10.3.2 Operations and User Services

Besides the science users of the EPs there are other groups who represent end users of the system. One of the main groups is composed of Operations and User Services personnel. These users will have different needs and therefore may have different requirements for the EPs than science users. This group of users may do most of their work "behind the scenes," however, they are often the science users' only link to the "insides" of ECS. It is anticipated that this group of EP users will spend a significant amount of time interacting with the science users and API developers to help them access EOS data and use the ECS. To make sure that the EPs will be able to accommodate this group's anticipated needs they have been included early on in the EP evaluation process.

Operations and User Services personnel participating in EP evaluation will be selected from those at the DAACs and at ECS in Landover.

10.4 EP Evaluation Results Integration

The process of feeding EP evaluation results back into the ECS design process begins with an EP Evaluation Results Forum (ERF), and continues with the use of the EP Evaluation Report as a direct input to the objectives setting and design phases of the next life cycle.

Evaluation Results Forum (ERF).

The ERF is conducted at the EDF by the data analysts to allow them the opportunity to present their findings, to allow developers to explore meanings and intent of indicated directions, and to assure evaluators that their inputs are properly reflected and clearly understood. A summary of the EP Evaluation Report will be presented at this forum, and the report itself will be distributed. The ERF presentation will follow the EP Evaluation Report table of contents as an agenda presenting a summary of each topic.

Those in the local EDF area are welcome to attend in person. Others will be invited to participate via teleconference.

EP Objectives and Design Update.

The EP Evaluation Report will serve as a direct input in the update of the EP Strategic Planning White Paper; the guiding direction for the EP process. An update of the white paper will be made at the end of each EP Evaluation.

EP Enhancement.

Each EP is meant to be a short-lived product that is enveloped by the subsequent EP in a expanding set of functionality. Consequently little effort is planned to enhance deployed EPs except for those fixes required to keep it operating.

The CST will remain in use throughout the Evaluation Period. Continued input on the EPs after the Evaluation Period is welcome through direct email to the EP Data Analysts and the User Recommendations Data Base (URDB).

11. EP Maintenance and Operation

The ECS M&O organization provides installation and check-out of EP COTS hardware and software, in the EDF and at each DAAC, wide-area communication necessary to support EP deployment and evaluation, DCE cell administration and support necessary for EP deployment and evaluation, and support services necessary to operate and maintain EP evaluation. EP6 will rely on the same wide area network communication that was used for the previous EPs. Table 11-1 summarizes the EP M&O Responsibilities.

Deployment of each EP at the DAACs and on host servers at the EDF constitutes a delivery to M&O status. As such, basic maintenance and operations functions must be performed by ECS. These include COTS installation and checkout, fault detection, reporting, and assisting in the resolution process, operating system administration, hardware and software maintenance, property management, configuration management, and resource scheduling.

No M&O personnel are planned for deployment to the DAACs sooner than November 1995 to support the Ir1 release. Consequently, until that time, all M&O services in support of the EP process shall be performed from the EDF at Landover, MD. The ECS DAAC liaison personnel shall provide coordination and support to EDF and on-site personnel.

As the EPs are not operational systems, (e.g., they do not generate deliverable products), the development organizations are responsible for software maintenance on the EPs .

Operation of the EP Workstations at the DAACs is the responsibility of the ECS DAAC Liaisons with assistance from the on-site M&O staff and the ECS EDF Help Desk.

Table 11-1. EP M&O Responsibilities

EP M&O Task	Responsible Organization
Installation and check-out of EP COTS hardware and software	ECS M&O (with assistance from the Development Organizations)
Software Maintenance	Development Organizations or ECS M&O
Hardware Maintenance - Project Equipment	ECS M&O
Hardware Maintenance - Hughes Capital Equipment	ECS M&O
EP Operations	ECS DAAC Liaisons with assistance from the ECS EDF Help Desk

Detailed description of M&O tasks are found in the remainder of this section.

11.1 M&O Evaluation Activities

M&O prototyping and evaluation activities are performed in two categories: those performed to support the activities of the ECS segments, and those performed to evaluate products and procedures for eventual use in ECS M&O functions.

11.1.1 M&O Support of ECS Segment Evaluation Activities

a. COTS product evaluations. M&O performs all actions to:

receive, coordinate, install, administer, manage, deinstall, ship evaluation products

brief status of all M&O evaluation activities to EP Team management

b. M&O provides computing and communication environments to host all ECS COTS and developed product evaluations.

11.1.2 M&O Function Evaluation Activities

a. ID processes, procedures, policies for evaluation

try them out in support of EPs

revise as required

b. ID products that could improve M&O efficiency

obtain for evaluation under 11.1.1.a above

11.2 EP COTS Property Management

M&O manages all COTS products purchased in support of the ECS Program, including those acquired to support EP computing and communication requirements. This responsibility covers both capital and program funded acquisitions.

11.3 EP COTS Product Installation and Check Out

11.3.1 EDF Activities

a. Initial Installation with assistance from Development Organizations. COTS products acquired to support EPs are received by the M&O organization at the EDF where they are unpacked, inspected, installed, checked out, and certified ready for use by EP developers.

b. Support to Development and I&T.

c. Shipment. Hardware and software to be shipped to DAACs in support of EP deployments is deinstalled and packed by M&O, and shipping contracts are let.

11.3.2 DAAC Activities

a. Facilities Planning. M&O performs facilities planning and coordination at the DAACs in coordination with facilities managers at each site. They are assisted in this coordination by the ECS Engineering liaison representatives.

b. Product installation. M&O personnel may travel to each site to install and check out EP products that require their level of expertise. However, some products may be installed by the ECS liaison at the site. Determination of method is made by the EP Team prior to shipment.

11.4 EP Configuration Management

Identification of EP hardware and software to an EP baseline is controlled from initial installation at the EDF through final delivery to assure ability to perform maintenance, track changes, and perform property management.

Three baselines are defined for each EP deployed for evaluation (software configurations for those EPs in development are managed by the developer):

1. Hardware Configuration. Defines workstation components.
2. Software Configuration. Defines application software installed.
3. Operating System/Services S/W Configuration. Defines UNIX and DCE setup.

All changes to these baseline configurations must be made under authority of a Configuration Change Request (CCR) approved by the appropriate CCB in accordance with ECS Program Instruction SE-1-002. Change board authorities are:

1. EP Configuration Control Group manages the Operating System/Services S/W Configuration,
2. EDF CCB manages no-cost changes to H/W and S/W configurations,
3. ECS CCB approves all expenditures for EP configuration changes.

11.5 EP Fault Resolution

A process for identification and resolution of faults in EP products has been establish by M&O (Figure 11-1). The process is centered in the EDF System Administrator (SA) and supported by the ECS Help Desk. The process operates from three key concepts:

1. Users need only deal with their local DAAC Liaison to resolve problems.
2. The liaison need only deal with the EDF Help Desk.
3. The EDF System Administrator is the focal point for fault diagnosis and coordination of corrective action.

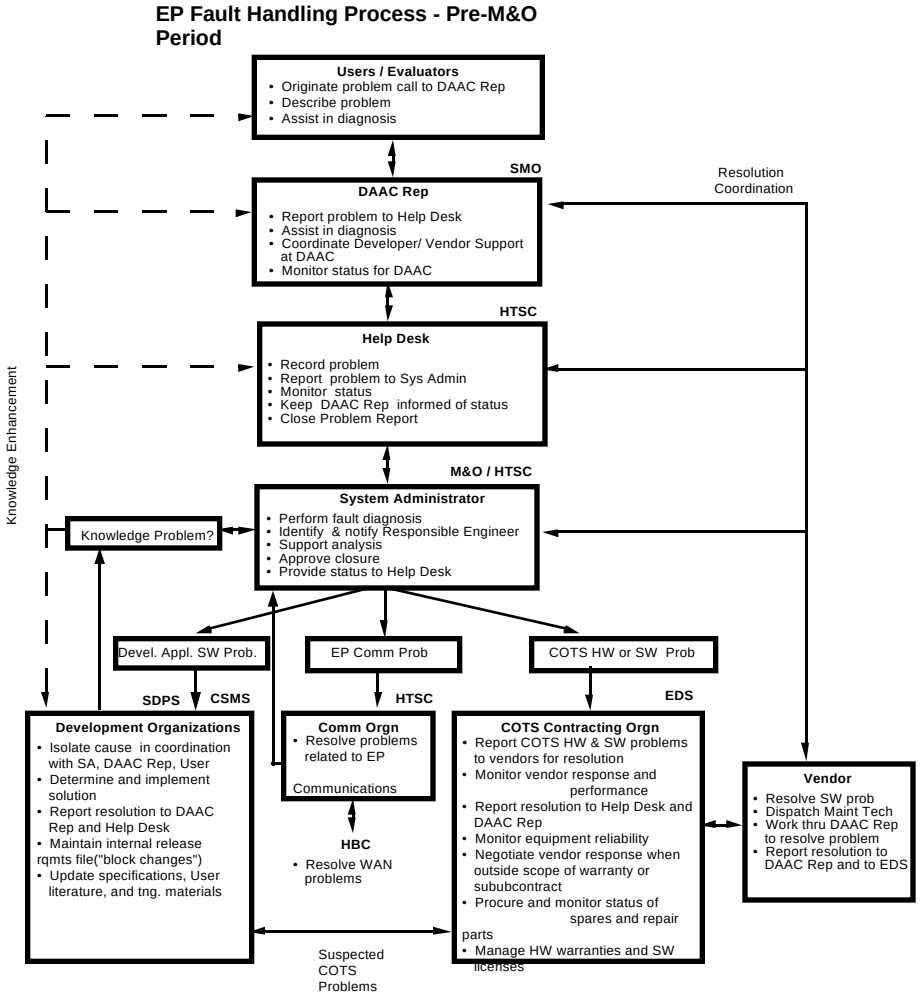

Figure 11-1. EDF Fault Handling Process

11.6 EP System Administration

During the period prior to M&O implementation at the DAACs, System administration for EP workstations is performed centrally by the EDF System Administrator, with selected support from DAAC Liaison personnel. The EDF SA will produce, distribute, train on, and maintain procedures for local SA operations. Roles of the SA in support of EP6 include:

a. Workstation/Server Backup

b. EP System Security

c. Workstation Shutdown and Reboot

d. Addition and Deletion of Users

e. DAAC System Configuration Modification

f. Installation of Software

g. Superuser Privileges

h. Workstation Housekeeping

Close cooperation must be practiced among the DAAC liaisons empowered to perform SA functions, the M&O personnel at the site, and the EDF SA. Our current plan allows all liaison personnel access to root functions to gain most efficient operation. All persons performing SA functions must exercise restraint and good judgment to avoid unnecessary system reconfigurations or builds. DAAC liaison personnel should always coordinate any planned change with the EDF SA before they perform it, and the EDF SA must always inform DAAC liaisons before making changes to the DAAC machines. The on-site M&O staff will assist the DAAC liaisons and the EDF SA on a time available basis. However the on-site M&O personnel will not receive any training on the EPs and will require instruction in any activity that they are asked to perform.

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Abbreviations and Acronyms

AFS	Andrew File System
API	Application programming interface
ASF	Alaska SAR Facility (SAR: Synthetic Aperture Radar)
CM	Configuration Management
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off-The-Shelf
CSMS	Communications and Systems Management Segment
CSR	Consent to Ship Review
CSS	Communications Subsystem (CSMS)
DAAC	Distributed Active Archive Center
DB	Data Base
DBMS	Database Management System
DCE	Distributed computing environment (OSF)
DD	Data Dictionary
DDTS	Distributed Defect Tracking System
DFS	Distributed File System
DME	Distributed Management Environment (OSF)
DNS	DCE Directory Service
DTR	Development Team Representative
ECS	EOSDIS Core System
EDC	EROS Data Center (EROS: Earth Resources Observations System)
EDF	ECS development facility
EDS	Electronic Data Systems
EOS	Earth Observing System
EP	Evaluation Package
EPRR	EP Readiness Review
EPS	Evaluator Preference Survey
ERF	Evaluation Results Forum

ESN	EOSDIS Science Network
ETM	ESDIS Technical Manager
FOS	Flight Operations Segment (ECS)
ftp	file transfer protocol
GSFC	Goddard Space Flight Center
GUI	graphical user interface
HDF	Hierarchical Data Format
HMI	Human-Machine Interface
HTML	HyperText Markup Language
HTSC	Hughes Technical Services Company
I&T	Integration and Test
I/Fs	Interfaces
IATO	Independent Acceptance
IDL	Interface Definition Language (OMG's CORBA Implementation)
IDL	Interface Definition Language (OSF DCE Implementation)
IET	Interactive Evaluation Tool
IP	Internet Protocol
ISO	International Standards Organization
ISS	Internetworking Subsystem (CSMS)
JPL	Jet Propulsion Laboratory
LAN	local area network
LaRC	Langley Research Center
LIM	Local Information Manager
M&O	Maintenance and Operations
MD	Master Directory
MIB	management information base
MIT	Massachusetts Institute of Technology
MSFC	Marshall Space Flight Center
MSS	Systems Management Subsystem (CSMS)
MUI	Management User Interface
NCR	Non-Conformance Report

NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center
OMG	Object Management Group
OODBMS	Object Oriented Database Management System
ORB	Object Request Broker
ORDBMS	Object Relational Database Management System
OS	Operating System
OSF	Open Software Foundation
OSI	Open Systems Interconnect
PGS	Product Generation Subsystem (obsolete ECS element name)
PI	Project Instruction
PSC	Pittsburgh Supercomputing Center
PO	Purchase Order
QA	Quality Assurance
RDBMS	Relational Database Management System
RPC	Remote Procedure Call
RTM	Requirements and Traceability Management
SDPS	Science Data Processing Segment
SEPG	Software Engineering Process Group
SGI	Silicon Graphics
SI&P	System Integration & Planning
SNMP	simple network management protocol
SOW	Statement of Work
T1	a common-carrier data pipe providing 1.544 Mbps of capacity
TBR	To Be Reviewed
TCP/IP	Transmission Control Protocol/Internet Protocol
TRMM	Tropical Rainfall Measuring Mission (joint US-Japan)
TRR	Test Readiness Review
UT	Usability Testing
V0	Version 0 (of EOSDIS)
WAN	wide area network